U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF SOILS.

IN COOPERATION WITH THE OREGON AGRICULTURAL EXPERIMENT STATION.

SOIL SURVEY OF JOSEPHINE COUNTY, OREGON.

BY

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[Advance Sheets—Field Operations of the Bureau of Soils, 1919.]

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[PUBLIC RESOLUTION—No. 9.]

JOINT RESOLUTION Amending public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, "providing for the printing annually of the report on field operations of the Division of Soils, Department of Agriculture."

Resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, be amended by striking out all after the resolving clause and inserting in lieu thereof the following:

That there shall be printed ten thousand five hundred copies of the report on field operations of the Division of Soils, Department of Agriculture, of which one thousand five hundred copies shall be for the use of the Senate, three thousand copies for the use of the House of Representatives, and six thousand copies for the use of the Department of Agriculture: *Provided*, That in addition to the number of copies above provided for there shall be printed, as soon as the manuscript can be prepared, with the necessary maps and illustrations to accompany it, a report on each area surveyed, in the form of advance sheets, bound in paper covers, of which five hundred copies shall be for the use of each Senator from the State, two thousand copies for the use of each Representative for the congressional district or districts in which the survey is made, and one thousand copies for the use of the Department of Agriculture.

Approved, March 14, 1904.

[On July 1, 1901, the Division of Soils was reorganized as the Bureau of Soils.]

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SOIL SURVEY OF JOSEPHINE COUNTY, OREGON.

By A. E. KOCHER, of the U. S. Department of Agriculture, In Charge, and E. F. TORGERSON, of the Oregon Agricultural Experiment Station.

DESCRIPTION OF THE AREA.

Josephine County is situated near the southwest corner of Oregon. Grants Pass, the county seat, is 297 miles south of Portland, and 474 miles north of San Francisco. The county is bounded on the north by Douglas County, on the east by Jackson County, on the south by the State of California, and on the west by Curry County. The western boundary is about 20 miles from the Pacific Ocean. The area surveyed occupies the eastern part of the county, and comprises only the part not included within national forests. Since the boundaries of the area conform to the numerous jogs in the outlines of the national forests, the area surveyed is exceedingly irregular in shape. Its length from north to south is about 50 miles, and its greatest width from east to west is 20 miles. It has an area of 765 square miles, or 489,600 acres.

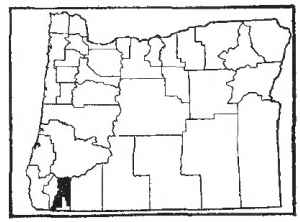


FIG. 1.—Sketch map showing location of the Josephine County area, Oregon.

Topographic sheets published by the United States Geological Survey were used as base maps for the greater part of the area. Some of these were made a number of years ago and required many corrections and additions to meet the cultural changes of recent years. Accurate base maps of the northwestern part of the area were not obtainable, and here the roads and larger streams were located by plane-table survey.

Josephine County, Oreg., lies entirely in the Siskiyou Mountains. It consists of an elevated region of unequal elevation, ranging between 900 and 5,000 feet, completely dissected by a youthful drainage system. The dissection is not uniform on account of the widely varying character of the rocks of the region. The mountain system is an old one in which many kinds of rocks have been intricately folded and subjected, apparently, to at least two cycles of erosion. The existing topography is that characteristic of a cycle still in its youthful stage but approaching early maturity, developed on an old erosional surface that was not smooth but much more so than any surface determined entirely by the folding of the rocks of the region. The existing topography has no relation whatever to that produced by the rock structure.

On account of the many different kinds of rocks in the county and their varying resistance to erosion the existing cycle of erosion has opened a series of lowland basins on the soft rocks and cut the areas of hard rocks into a series of extremely rugged mountains of dissection. The lowland areas are irregularly scattered over the area, though in a rough way they consist of a large central basin surrounding Grants Pass, a string of small isolated basins extending northward from this to the northern boundary of the area and beyond, a string of basins extending southwestward from the southwestern "corner" of the Grants Pass basin, expanding into a rather large area around the towns of Kerby and Holland, and a string stretching southeastward from the southeast corner of the Grants Pass basin along the valley of Applegate River and its tributaries. An inspection of the map will show the details of the distribution described, each basin being marked by a patch of several colors, representing the various soils identified and mapped in it, while the mountainous areas surrounding the basins are shown in one single color representing Rough stony, and, therefore, nonagricultural land. Many of the basins are narrow valleylike belts and usually are traversed by a stream. That they are not mere river or creek valleys but, although they have been formed by the streams occupying them, must be classed as basins whose shape and size is determined primarily by the distribution of belts of rocks of slight resistance to erosion, is shown by the contrast between them and the valleys of the same streams outside the basins. Compare, for example, the valley of Grave Creek west of where the railway leaves it below Leland station with the basin portion of the valley between Placer and the junction of Grave and Wolf Creeks. A more striking case is the valley of the Illinois River below the turn 2 miles north of Kerby with the Kerby Basin, which is a part of the Illinois Valley. The Rogue River Valley above the Grants Pass Basin as well as below it, compared with the basin itself, is another illustration of the same relationship.

The basins themselves are in many cases somewhat hilly. This is true mainly of the larger ones, such as the Grants Pass Basin. The smaller ones as a rule have been made smooth by the long alluvial fans that have been spread out in them by small streams, either perennial or intermittent, descending from the surrounding mountains.

All of the drainage waters of the area eventually reach the Pacific Ocean through the Rogue River. This stream, which crosses the central part of the area in a westerly direction, has a fall of about 300 feet and maintains a strong continuous flow throughout the year. It is deeply intrenched through the agricultural part of the valley, consequently destructive overflows are exceedingly rare, and up to the present time the water has not been available for irrigation except by pumping.

In general, the agricultural parts of the area are well drained, although there are narrow strips at the outer edge of the Rogue and Illinois Valleys that remain wet in the spring and would be improved by artificial drainage. All the streams have good fall and are still deepening their channels. There are several rapids in Rogue River with potential value as waterpower sites. As yet, however, no power has been developed within the area, although the dam now under con-

struction at the county boundary is expected to furnish considerable electrical energy.

Josephine County was formed in 1856, being one of the first counties in the State to be organized. At first the county seat was at Waldo, and later at Kerby. About 1883 a part of Jackson County was added, and the county seat was moved to Grants Pass. The early settlers were of mixed nationalities, attracted to the region by the rich deposits of gold. Many of the first settlers packed over the mountains from Crescent City, Calif., and established mining camps at various points throughout the Illinois Valley. Some of these camps, now all but deserted, were thriving villages during the early years, with populations of 2,000 to 3,000 or more. The early mining operations were confined to washing the stream gravels, which were unusually rich in gold. As the richer and more easily worked deposits became cleaned up, many of the original prospectors moved on in search of fresher fields, resulting in the permanent population falling off to little more than half of what it had been. However, with the miners and prospectors had come a number of homeseekers. These established several water rights for irrigation on Sucker and Althouse Creeks prior to 1860.

In 1880 the population of the county was 2,485. The 1920 census gives the total population as 7,655, of which 3,151 is credited to Grants Pass, and 4,504, or 59 per cent, is classed as rural. The most thickly settled sections are in the valleys, large areas of mountain lands—about half the county—being included in national forests and uninhabited.

The principal towns in the area are Grants Pass, the county seat, with a population of 3,151, Merlin and Hugo located on the main line of the Southern Pacific Railroad, and Kerby, situated 30 miles southwest of Grants Pass in the Illinois Valley. Other towns and settlements with 50 to 100 inhabitants are Galice, Leland, Wolfcreek, and Grave, in the northern part of the area; Browntown, Holland, Selma, Takilma, and Waldo, in or near the Illinois Valley; and Williams, Davidson, Murphy, and Wilderville, in the Applegate Valley.

Only the central and northern parts of the area surveyed are supplied with transportation facilities. The main line of the Southern Pacific Railroad extending north from San Francisco to Portland enters at about the middle of the east side of the area and runs along the Rogue River to Grants Pass, where it swings north, passing through Merlin, Hugo, Leland, and Wolfcreek, giving direct communication with Portland. The California & Oregon Coast Railroad, a local line, extends 16 miles southwest of Grants Pass and is of importance to the mining and lumbering industries in the section adjacent to the Illinois Valley. The Pacific Highway, which is being hard-surfaced, roughly parallels the Southern Pacific Railroad. An auto stage road extends from Grants Pass through the Illinois Valley to Crescent City. The valleys are well supplied with roads, but extensive mountain areas have no roads of any kind. Rural mail and telephone lines reach all parts of the valleys, and good schools and churches are located at convenient intervals.

Portland and San Francisco constitute the principal outside markets for cherries, peaches, and other perishable fruits, while most of the apples and pears are shipped to eastern cities. Considerable cream is marketed in Portland and Independence, Oreg. Grants Pass also provides a small local market for milk and vegetables.

CLIMATE.

The valleys of southern Oregon are justly famed for their mild and healthful climate. In general the year consists of a wet and a dry season corresponding, respectively, to winter and summer. The temperature is favorable to the growth of a wide range of crops. Although the yearly rainfall is apparently sufficient for crop production, its distribution is unfavorable to the maintenance of a moisture supply in the soil, and successful dry farming is restricted to certain soil types and conditions. For this reason most of the gravelly terrace soils and all those derived from granitic materials are unsuited to dry farming, and attempts to farm them without irrigation have not been wholly successful. On the other hand, some of the lower terrace soils have given fair to good crops of grain, and a few of the high terraces and hillsides near Grants Pass have given a fair, though unsatisfactory, orchard growth without irrigation. In some localities, where soil conditions are favorable, dry-farmed vineyards, cherries, and other small fruits give profitable yields, though both quality and yield would generally be improved by irrigation.

According to the records kept by the United States Weather Bureau for the past 29 years at Grants Pass, the mean annual precipitation at this place is 31.78 inches. Of this amount more than 75 per cent comes during the months of November to March, inclusive, and 43 per cent of the remainder during October, April, and May. That is, the total summer rainfall, from June to September, inclusive, is only 2.32 inches. During these months there is usually a period of several weeks without a trace of rain. In the mountain districts the precipitation is heavier and in the winter is mostly in the form of snow. Most of the rainfall comes as slow, gentle rains, extending over several days, torrential rainstorms being very rare. The records show that the total precipitation for the wettest year (1909) was 43.83 inches, of which 15.3 inches occurred in January. For the driest year (1898) only 17.77 inches was recorded, the deficiency occurring entirely during the winter months.

The snowfall varies greatly from year to year but is always very light in the valleys. The average snowfall at Grants Pass is 9.7 inches. Snow usually forms but a thin covering, and remains on the ground only a few days at a time. In the mountains the snow reaches a depth of several feet, and on some of the higher peaks it does not disappear until midsummer.

Fog is of common occurrence during the rainy season, especially in the Illinois River Valley, which lies relatively near the ocean, and throughout all the mountainous districts of the survey. The summers, however, are nearly cloudless, with a low relative humidity.

The following table gives the normal monthly, seasonal, and annual temperature and precipitation, as recorded by the Weather Bureau station at Grants Pass.

Normal monthly, seasonal, and annual temperature and precipitation at Grants Pass.

(Elevation, 956 feet).

Month.	Temperature.			Precipitation.			
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year (1898).	Total amount for the wettest year (1909).	Snow, average depth.
	°F.	°F.	°F.	Inches.	Inches.	Inches	Inches
December	38.9	77	5	5.15	2.26	5.01	1.5
January	38.9	71	0	6.36	1.78	15.30	4.7
February	42.6	75	10	4.51	3.70	7.32	1.7
Winter	40.1	77	0	16.02	7.74	27.63	7.9
March	46.6	86	18	3.35	.98	1.09	.9
April	51.3	94	21	1.76	.41	.14	T.
May	56.8	99	24	1.70	1.90	.29	.0
Spring	51.5	99	18	6.81	3.29	1.52	.9
June	62.1	104	31	.94	.85	.78	.0
July	69.3	110	33	.20	.00	.29	.0
August	68.6	108	33	.26	.05	T.	.0
Summer	66.6	110	31	1.40	.90	1.07	.0
September	61.3	103	24	.92	.57	1.03	.0
October	53.5	93	20	1.93	1.40	3.39	.0
November	44.4	75	12	4.70	3.87	9.19	.9
Fall	53.1	103	12	7.55	5.84	13.61	.9
Year	52.8	110	0	31.78	17.77	43.83	9.7

The mean annual temperature at Grants Pass is 52.8° F. The mean temperature for the winter is 40.1° F.; for the spring, 51.5° F.; for the summer, 66.6° F.; and for the fall, 53.1° F. The highest recorded temperature is 110° F., and the lowest is zero. Temperatures of 100° or more are common from June to September, inclusive, and temperatures of 71° or more have been recorded during every month of the year. Owing to the low relative humidity the high summer temperatures are not oppressive, while the nights are usually cool and refreshing.

Late spring frosts sometimes do damage to fruits, vegetables, and even general farm crops, but the occurrence is not frequent, and very little provision is made for smudging orchards. The latest frost in the spring recorded at Grants Pass occurred on June 29, and the earliest in the fall, September 6. The average date of the last killing frost in the spring is May 15, and the average date of the earliest in the fall is September 20. This gives a normal growing season of 128 days. Frost conditions vary somewhat in different parts of the area surveyed. Thus, it is said the springs are a week to 10 days later in the Illinois River Valley than at Grants Pass. However, it is also said that the ripening season is approximately the same in this and the other valleys, the vegetation making a more rapid growth after the late start.

The area surveyed is remarkably free from hail, winds, lightning, or violent storms of any kind. Lightning sometimes does damage to timber in the surrounding mountains, but it is almost unknown in the valleys.

AGRICULTURE.

Although Josephine County was among the first in the State to be settled, the interest of the early inhabitants was centered on mining rather than agriculture. Mining operations began in southwestern Oregon as early as 1848, and since that date mining has played an important part in the development of the region. During the first few decades only enough crops were grown to supply the local demand, there being no railroads or other means of shipping to outside points. With the building of the Southern Pacific Railroad in 1883, distant markets were opened for lumber, and for a number of years thereafter lumbering was the leading industry. Thus during the first half century of the county's history there were only a few people engaged in agricultural pursuits, and even in recent years the development of agriculture has been slow. The first settlements were confined to the valleys, where cultivation was easy and good yields could be obtained without irrigation. Cattle were raised and grazed in the hills, although little attention was given to forage crops for winter feeding. Then, as now, wheat, oats, corn, and vegetables were among the leading crops grown, with small patches of fruit for home consumption.

According to the United States census of 1880, wheat was the principal crop grown in 1879, occupying 1,497 acres, with a production of 20,431 bushels. Oats occupied 944 acres, producing 17,621 bushels; corn, 528 acres, yielding 8,335 bushels; barley, 299 acres, with a yield of 5,421 bushels. Hay was grown on 3,456 acres, producing 4,582 tons. There were 32,283 bushels of potatoes harvested, 378 bushels of beans, and 175 bushels of flaxseed. The value of all orchard products was $10,737; market-garden products, $3,127; and forest products sold, $7,896.

In 1889 the acreage of wheat was slightly smaller, and the acreage of oats and corn was considerably greater. Hay was grown on 4,836 acres, yielding 7,740 tons; and potatoes on 222 acres, returning 21,742 bushels. Hops were beginning to be grown, 65 acres yielding 68,993 pounds. There were 18,772 apple trees, with a production of 24,654 bushels; and 8,089 peach trees, yielding 8,813 bushels.

During the next decade the most important change in the agriculture of the county was a marked increase in the acreage of hay and forage crops. About this time it was discovered that alfalfa and clover could be successfully produced, and the introduction of these crops did much toward making the agriculture of the county permanently profitable. For a number of years many of the fields had been cropped continuously to wheat or other small grains until the supply of organic matter had become so nearly exhausted that yields were much less than formerly. After the introduction of alfalfa and clover more live stock was kept and fed on the farms, with the result that many of the fields out of condition were brought back to their former state of productiveness. In 1899 the combined acreage of hay and forage crops, including grains cut green for hay, amounted to 8,716 acres, or nearly 66 per cent of the total cultivated area. Of this, clover occupied 1,082 acres, with a production of 2,709 tons; alfalfa, 788 acres, producing 1,820 tons; other tame grasses, 1,383 acres, yielding 2,309 tons; 4,458 acres of grain cut green for hay produced 4,948 tons; and wild grasses, 900 acres, giving

1,059 tons. The acreage and production of wheat, oats, corn, barley, and rye remained practically at the same low figures as during the preceding two decades. The plantings of apples had increased to 75,371 trees and the production to 32,283 bushels. There were 21,025 peach and nectarine trees, producing 16,938 bushels; and 31,116 grape vines, from which 233,900 pounds of grapes were harvested.

During the next 10 years, from 1899 to 1909, the value of all agricultural products increased from $262,936 to $770,830. Corn, oats, wheat, and rye fell off markedly in acreage, but the area devoted to hay and forage crops was nearly doubled. This change in conditions is largely attributable to the extension of irrigation, the crops showing an increase in acreage being alfalfa and other tame grasses, which are grown on irrigated lands. The number of apple, peach, and nectarine trees declined during this decade about half. There was a substantial increase in the number of grapevines, and pears were beginning to receive attention.

The tables below, compiled from the census reports, show the acreage and yield of the leading field crops and the number and production of the fruit trees and grape vines in the county in 1909 and 1919.

Acreage and production of leading field crops in 1909 and 1919.

Crops.	1909		1919	
	Area.	Production.	Area.	Production.
	Acres.	*Bushels.*	*Acres.*	*Bushels.*
Corn	532	9,036	822	19,693
Oats	544	11,892	690	18,255
Wheat	596	8,417	1,923	27,243
Barley	167	5,155	762	15,139
		Tons.		*Tons.*
Hay and forage	9,898	17,028	10,856	21,150
Tame hay	5,136	10,389	5,414	12,714
Alfalfa	2,377	5,768	2,930	8,655
Grains cut green	4,471	5,636	4,102	4,732
		Bushels.		*Bushels.*
Potatoes	349	40,417	211	21,948
Other vegetables	553	.....	42	.....
		Pounds.		*Pounds.*
Hops	248	156,000	109	93,000
		Quarts.		*Quarts.*
Small fruits	97	115,425	77	64,507

Number of fruit trees and grapevines and production of fruit in 1909 and 1919.

Kind.	1909		1919	
	Trees and vines of bearing age.	Production.	Trees and vines of bearing age.	Production.
	Number.	*Bushels.*	*Number.*	*Bushels.*
Apples	43,299	34,388	76,108	105,407
Peaches	[1] 11,175	16,513	28,902	19,276
Pears	4,819	7,740	45,883	25,757
Plums and prunes	6,635	4,195	11,675	9,128
Cherries	1,183	816	9,904	3,060
		Pounds.		*Pounds.*
Grapes	41,869	184,752	70,374	301,524

[1] Includes nectarines.

These tables show that hay and forage crops continue to be the most important field crops in the county. Wheat and barley show a decided increase in acreage in 1919, the acreage devoted to potatoes, other vegetables, and hops is much smaller, and the number of fruit trees and grapevines is much greater.

According to the census there were 9,093 cattle in the county on January 1, 1920, consisting of 4,813 beef cattle and 4,280 dairy cattle. In addition there were 1,560 horses, 146 mules, asses, and burros, 2,325 sheep, 1,223 goats, 3,932 hogs, 29,769 chickens, and 599 colonies of bees.

At the present time the agriculture of Josephine County consists of the growing of general farm crops, mostly for home use, fruit growing, and dairying. The principal crops are alfalfa, apples, and pears. Wheat, corn, potatoes, and vegetables are grown in a small way on nearly every farm, wheat being a cash crop, and the others being used mainly on the farms. Barley, oats, and clover occupy a small acreage, while grapes are beginning to assume importance as a cash crop in the vicinity of Grants Pass.

The following table, compiled from information furnished by the Southern Pacific Railroad, gives the amount of agricultural products shipped from Grants Pass by freight during the year 1918. In addition, there was some fruit and cream shipped by express.

Shipment of principal agricultural products from Grants Pass in 1918.

Commodity.	Cars.	Commodity.	Cars.	Commodity.	Cars.
Cattle	31	Molasses [1]	14	Pulp [1]	1
Pears	29	Hay	9	Hogs and sheep	6
Apples	26	Wheat	3		
Sugar [1]	25	Hops	1	Total	145

[1] A beet-sugar factory was operated at Grants Pass for one year, but because of the difficulty of obtaining beets in sufficient quantities, the plant was removed about 1916.

A study of the foregoing statistics would seem to indicate that the agriculture of Josephine County has undergone but little change during the last four decades. The figures also show a comparatively small agricultural production, which is due to the fact that agriculture is confined to small valley tracts. With the extension of irrigation several thousand acres of additional land could be used for cultivation, although the total area in cultivated crops must necessarily remain comparatively small, since the uplands can not be irrigated, and under the prevailing climatic conditions many of them are unsuited to dry farming.

Alfalfa is the most important crop, since it forms the foundation of the dairy and other live-stock industries. It is confined to the valley soils where irrigation can be supplied or where the lands are naturally moist. The greater part of the crop is fed to work stock and dairy cattle, only 9 cars of hay being shipped from the county in 1918. On account of the good demand for hay and the marked adaptability of the valley lands to the production of alfalfa, the opportunities for extending the acreage of this profitable crop are excellent wherever water can be had for irrigation.

Pears constitute one of the principal cash crops. The trees respond well to irrigation, returning heavy yields of fruit of good

quality. At present a large part of the crop is unirrigated, although steps are being taken to supply the orchards with water in another season. The leading varieties are the Bartlett, Anjou, Howell, and Comice. During 1918, 29 cars of pears were shipped by freight from Grants Pass.

Apples are of about equal importance with pears, and are also confined mainly to the alluvial soils of the Rogue River Valley. A number of the lower lying orchards are irrigated by pumping from the streams. In orchards on the higher lands, without irrigation, only a moderate growth of tree is obtained, and the yields and size of the fruit are considerably below those produced under irrigation. The leading variety is the Yellow Newtown, to which the soils of the valley seem especially adapted. Some excellent orchards of Winesap apples are being grown on the soils of the Columbia series, with yields ranging as high as 1,000 boxes per acre. The total production, however, is small, only 26 cars being shipped from Grants Pass during 1918.[1]

During the last few years wheat has again assumed some importance in the county. This crop is grown without irrigation, and the best results are obtained with winter varieties. The yield of spring-sown wheat is undependable, as the ripening takes place so long after the spring rains cease that the crop frequently suffers from drought. In unfavorable seasons wheat is cut for hay.

Oats and barley are grown in a small way throughout the Rogue and Illinois River Valleys. These grains are not irrigated, and the condition of the crops in early summer determines whether they shall be cut for hay or allowed to ripen. A considerable proportion of the oats and barley is cut green. These crops are used on the farms for feeding stock.

Corn is one of the locally important crops, although it is confined mainly to small fields on the alluvial soils in the Rogue River Valley. In the past it was used chiefly for feeding work stock and hogs, but during the last two years an increasing acreage has been used for silage. The lowlands are well adapted to the production of corn, good yields being obtained without irrigation. Ordinarily, however, the summer rainfall is too light for successful corn growing on the uplands without irrigation.

A small acreage of hops is grown in the vicinity of Grants Pass, on the deep, mellow soils of the Columbia series. During the last few years of high prices the crop has proved very profitable. Potatoes and garden vegetables are grown on nearly every farm, but none for sale outside of the county.

In recent years an increased interest has been taken in dairying, although it is still conducted on a comparatively small scale. For a time butter was manufactured commercially at Grants Pass, but this has been discontinued and the industry now is confined to shipping cream to the creameries at Portland and Independence. The dairy herds are small, usually containing from 3 to 8 cows each, and are made up mainly of grade Jerseys and Holsteins, as well as a small number of Guernseys. The industry is of the year-round

[1] Nearly all shipments of agricultural products from the county are made from Grants Pass.

type, many of the dairymen having recently equipped their farms with silos.

Opportunities exist for extending the dairy industry and increasing the acreage of feed and forage crops. At present the amount of feed produced is insufficient to supply the local needs, and considerable quantities of hay and grain are shipped in.

The topography and character of the soils have had a marked influence on the development of agriculture. Not only is a large proportion of the county too rough or mountainous for cultivation but considerable areas of the terrace soils are underlain by dense or partly cemented layers that greatly reduce their water-storing capacity and lessen their value for dry farming.

The adaptation of the soils to various crops is recognized. Thus the soils of the Columbia series are known to be the best all-round soils for alfalfa, clover, fruit, and cultivated crops. The terrace phase of the Columbia soils and the soils of the Kerby and some of those of the Corning series are only slightly inferior to the typical Columbia soils for alfalfa when irrigated, but they are unsuited to this crop without irrigation. The "red hill" soils of the Aiken and Olympic series occupying the lower hillslopes are well suited to fruit, and they are better adapted to grapes than the lower lying types. The Siskiyou, Holland, and Barron soils are of inferior quality and not well adapted to the crops of the region.

In growing alfalfa the land is usually prepared in the fall, and seed sown without a nurse crop early in the spring. Superphosphate at the rate of 150 to 200 pounds per acre, is generally applied at seeding time, and thereafter a like amount is applied each fall. The crop is irrigated once before the first cutting and twice before each succeeding cutting. Four cuttings are usually made, although in some cases the last crop is used for pasture instead of hay. All of the dry-farmed orchards are given clean cultivation. In some of the irrigated orchards alfalfa is planted and allowed to remain for a number of years, while in others clover is planted every other spring and plowed under in the fall, the land receiving clean cultivation every other summer.

The farm buildings and improvements throughout the Rogue River Valley are good, but in more remote sections they are only fair. The work stock consists of light to medium weight horses, practically no farm work as yet being done with tractors.

In general no definite system of crop rotation has been practiced in Josephine County, alfalfa being allowed to occupy the fields as long as the yields are profitable. Of late, however, a 10-year rotation is being established by some, in which alfalfa occupies the land 6 years, corn 2 years, and small grains, usually barley or oats, 2 years.

Only a small amount of commercial fertilizer is used in the county, although the amount is increasing annually. In 1909 only 34 farms, or 4 per cent of the total number, reported its use, the total expenditure being only $762. In 1919, 166 farms reported a total expenditure of $7,241. Superphosphate is about the only fertilizer used, and is applied to alfalfa. In some of the orchards alfalfa, clover, or vetch is plowed under as a green-manure crop.

The supply of farm labor is fairly abundant, and the quality is good. Most of the laborers are Americans. Women do much of the

labor of picking, sorting, and packing fruit, and women and children are employed for picking hops. About $3.50 a day is the average wage paid. Apples are frequently picked and packed by the box, 6 cents per box being paid for each operation. In 1919 the total amount paid out for labor was $144,747, reported from 320 farms.

Of the total area in Josephine County, 9.3 per cent is reported by the 1920 census as in farms. There are 727 farms, with an average size of 133.8 acres, of which 30.4 per cent, or an average of 40.6 acres per farm is classed as improved. The records show a considerable reduction in the average size of farms during the last 40 years.

According to the 1920 census, 79.2 per cent of the farms were operated by owners, 16.9 per cent by tenants, and 3.9 per cent by managers. Tenants usually rent on the share basis, receiving either one-third or one-half of the crop, depending on whether or not the owner furnishes the work stock and implements.

Irrigated valley lands improved for general farming sell for $150 to $250 an acre. Well-improved orchards sell for $350 to $1,000 an acre. Unimproved lands, suitable for irrigation, but at some distance from markets, can be bought for $25 to $35 an acre. The price of the rough-hill land varies greatly, its value being determined by location, topography, and the stand of timber.

SOILS.[2]

The soils of Josephine County, with the exception of those on small areas of somewhat poorly drained land, are light in color, are free from accumulations of salts or of lime carbonate, possess, as a rule, heavier subsoils than soils, and have developed under forest cover, though locally the forest is open and there is a thin growth of grass among the trees. The county lies in a region that in one respect is unusual for the United States. Southwestern Oregon and northwestern California lie in a region where the minimum rainfall amounts to a little more than 30 inches and the maximum is considerably higher. The rainfall in the lowland basins is lowest and on the mountains highest. Since the agriculture is confined to the basins the rainfall on the mountains, so far as dry farming is concerned, may be disregarded. The minimum rainfall seems to occur in the Grants Pass Basin, precipitation apparently increasing slightly toward the west and south, though it may be assumed that any difference in the various basins are too small to have any important effect on their agriculture. This is made more worthy of general acceptance because of the fact that the rainfall occurs during the winter season, and the amount of moisture being held by the soil for the summer crops is thus seen to be due more to the character of the soil than to small differences in the amount of precipitation, as the minimum amount is sufficient to saturate the soil throughout its whole thickness or depth. That this is true for the whole region and as a prevailing rather than an exceptional condition is shown by the soils themselves with their typical humid characteristics. The soils of the whole region are typical humid soils.

[2] The soils mapped in Josephine County do not join those of the Medford area in Jackson County. The Medford area was mapped 10 years ago, at a time when knowledge of the soils in Oregon was much less than now. In addition to this, the land along the western boundary of the Medford area was not mapped with as much detail as the smoother and more valuable agricultural land in the vicinity of Medford and Ashland. Because of these two factors, the two maps do not join in places along the boundaries.

Not only are the soils identical in their general characteristics with the humid soils of the world as a whole, but the vegetation is that of a humid climate. It is a forest region and one in which the forest growth, except locally, is luxuriant. As a general rule, the forested regions of the world have a supply of moisture sufficient to insure the production of crops without irrigation. The timbered regions of the world are those in which a varied agriculture is widely developed and stands on a secure basis.

This is not true of a small region that includes Josephine County. While agriculture without irrigation is safe on the best soils, it is not universally so. Even on the most favorable soils, failures or greatly reduced yields are all too frequent. This happens frequently enough to have a somewhat depressing effect on the agricultural development of the region. The region is unique, therefore, in having a rainfall of more than 30 inches annually, which is sufficient to promote a good growth of forest trees and yet is not entirely adequate for the safe and consistent production of staple agricultural products, somewhat more risk being involved than in most regions of equal precipitation and similar native vegetation.

The explanation lies in the distribution of the rainfall. It falls in winter, the summer months being practically rainless.

While this is a disadvantage in nonirrigated agriculture, there are certain features of the soils of the region that constitute an advantage to irrigated agriculture that are not present in many regions where irrigation is or has been practiced. Most of the irrigated regions of the world are situated in deserts, or at least in regions with low rainfall, and the soils irrigated are those developed under desert conditions. One of the features characteristic of desert soils, as a whole, though not necessarily true of every individual desert-soil type, is the presence of a high percentage of mineral matter. In fact, it may be stated without any reservation or exception that all desert soils have a higher percentage of certain mineral constituents than are found in humid soils. In many desert soils this is so high as to constitute what is known as alkali, and therefore a menace to agriculture. In most irrigated regions the threat of alkali accumulation is always present, locally at least, and often over a large part of the area. It has been stated by some students of agricultural conditions through long periods of time that alkali finally invades every irrigated region sufficiently to become a menace to its industries, the statement applying, of course, to the usual irrigated regions on desert soil.

The conditions in Josephine County are entirely different from those existing in the usual irrigated region. The soils have not only not developed under desert conditions, but they are entirely different in their fundamental characteristics from desert soils. They are identical in these broad features with humid soils. They have no accumulations of alkali in either soil, subsoil, or substratum. There can be no danger whatever from alkali invasion of this region when placed under irrigation with any water that is available to it. Even the seepage water from irrigation ditches can not be considered a menace from the alkali point of view, although on account of water-logging, drainage must be provided for such areas. The problem of the irrigating farmer in this region will not be one concerned with alkali.

The subsoils of some of the soil types are rather heavy, and therefore will permit only a slow penetration of moisture, but that can be taken care of by regulating the amount of water placed on the land or by providing drainage. The farmer will in time, in order to grow large crops in this region, be required to use fertilizer or farmyard manure, or both, but this is a simple matter when compared with the alkali problem.

The problems to be met with in the irrigation of the region are mainly engineering problems. The soils are safe and with proper care will be productive and will remain so.

The soil materials have originated through the breaking down of the country rocks, and have been accumulated either in place through decay of the rock or in areas more or less remote from the place of origin through erosion and deposition by water. The soils vary considerably in detail, though much alike in the broad features of color, structure, and profile. The variations are due to topography and to character of parent material.

On the basis of differences in the mode of accumulation, the soil-forming materials may be grouped into three general classes: (*a*) Residual materials, (*b*) old valley-filling materials, and (*c*) recent-alluvial deposits. In addition, there are the miscellaneous types of Riverwash, Rough stony land, Rough mountainous land, and Placer diggings.

The residual materials have been derived through the weathering of consolidated rocks in place. Except for local changes in position caused by gravity and surface washing on the slopes, they retain the same position held by the parent rock. However, since the operation of these agencies is constant, the movement of these materials is more or less continuous, and while the underlying rocks are undeniably old, the soil-forming materials are geologically young. Their youth is reflected in very definite conditions of structure that are characteristic of all of the residual soil-forming materials in the area. The surface materials are friable and commonly contain fragments of the parent rock. They are not given to baking and rarely contain an appreciable amount of humus below the surface inch. While iron is present in abundance, as is indicated by the occurrence of iron-cemented pellets or brown ferruginous materials, there is no definite well-cemented hardpan in any of the soils. The subsurface materials are compact, usually rather heavy in texture, and grade into the unaltered parent rock through partly disintegrated rock. The depth of the weathered material is variable, owing in part to the lack of uniformity in the rate of weathering and in part to the different rates at which the surface material has been removed by erosion. Throughout all of the residual soils bedrock may be found at any depth between 1 foot and 20 feet. While this group of soils is the most extensive in the area, it is confined entirely to the hilly and mountainous region.

In striking contrast to the soil-forming materials on the hills are the maturely weathered old valley-filling deposits. Although geologically they are classed as recent, from the standpoint of soil formation they are old. Originally derived from residual materials, they no longer occupy their place of origin, but have been trans-

ported to smooth foot slopes and valley floors where the appreciable movement of the particles has long since ceased and where the processes of weathering have proceeded uninterruptedly under strikingly significant conditions. The most important factor in the weathering of these deposits is a climate of heavy winter rainfall followed by an extended period of aridity. Thus in early summer the materials pass quickly from a state of oversaturation to a condition of extreme dryness. The accumulation of humus, with its beneficial effects, is accordingly discouraged. Furthermore, the winter temperatures are so mild that frosts have had but little action on the soil materials. Combined with these conditions is the presence of a quantity of iron compounds in the soil materials. The result is a large group of unconsolidated deposits with distinctive and characteristic features, among the most constant of which are the sharp distinctions between surface soil and subsoil. The subsoils tend to be heavier in texture than the surface soils, are more compact, and in places are impervious and refractory. In some places the refractory nature is due to a stratum of heavy clay, but more commonly to a partial consolidation or cementation of the subsoil materials through iron solutions. Throughout the deposits laid down by streams partly cemented gravels are common in subsoils and substrata.

The old valley-filling deposits are very extensive in Josephine County and occupy the valleys almost to the exclusion of recent alluvium. Since being deposited the materials have been elevated and subjected to erosion, so that at the present time they occur not only as broad continuous sheets over most of the valleys, but also as more elevated marginal terraces, the remnants of former deposits. In places where they extend short distances up the slopes they consist entirely of alluvial-fan or footslope material. Waterworn gravels and small angular rock fragments are abundant. These deposits have a smooth or gently sloping topography and an elevation well above the present flood plains.

The recent-alluvial deposits, while important agriculturally, are very small in extent. They occupy narrow strips in the lowest parts of the valleys adjacent to the streams and low marginal depressions at the foot of terraces. Except for a slightly billowy surface due to overflows, the topography is generally smooth. Drainage is in general well established; only the marginal areas already referred to are poorly drained. The differences distinguishing the recent-alluvial deposits from the old valley-filling deposits are the absence of a semiconsolidated or partly cemented layer in the subsoil, uniformity of structure throughout the 6-foot section, and a somewhat higher content of organic matter.

The rocks of Josephine County include both igneous and sedimentary formations and therefore have a wide range in character and composition. Moreover, many of them have been crushed and highly metamorphosed or altered through extensive earth movements, heat, and percolating waters, making their occurrences very irregular and complex. The igneous rocks, comprising both deep-seated igneous and volcanic effusive materials, include greenstones, serpentine, granodiorite, porphyry, andesite, and possibly basalt with their altered or metamorphosed derivatives.[3] The greenstones are abun-

[3] Mineral Resources of Southwestern Oregon, Bul. 546, U. S. Geol. Survey.

dant and of several different kinds, but all are metamorphosed greenish-colored rocks containing chlorite and green hornblende. They are the dominating rocks east of Grants Pass, where they occur generally over a wide strip extending north from the Applegate River to beyond the summit of Sexton Mountain near Grave Creek. Smaller bodies occur at Waldo, Takilma, and Holland. The areas of serpentine are usually small but widespread in occurrence. As a rule their boundaries are sharply defined, since the rock clearly cuts the great masses of greenstone. Prominent exposures are seen at Waldo, Holland, and on Sexton Mountain, and a large body skirts the area surveyed west of Selma and Kerby. Aside from the granodiorite, all of the above-named rocks break down into materials of similar character. However, differences in topography and erosion, together with the attendant marked differences in the manner and degree of weathering, have resulted in the formation of a number of soil series with distinct and characteristic attributes. The same is true of the soils derived from granitic rock. Here, above all else, age of soil material or stage of soil maturity is the most important factor. The rock itself is usually dark gray in color, granular in structure, and in most cases is coarse grained. It varies considerably in composition, but is composed mainly of feldspar, quartz, hornblende, and mica. In most places it is somewhat basic in character and includes quartz diorite, while in other localities it is more acid and approaches a true granite. It occupies large areas in the vicinity of Grants Pass, and smaller ones on Williams Creek in the southeastern part of the area surveyed.

The sedimentary rocks, consisting of slates, shales, and sandstones, are widely distributed and as a rule occur in large masses. The slates are dark-colored fine-grained rocks of varying degrees of hardness. The shales are gray or light brown in color, are usually soft, and weather into brown or reddish-yellow materials. The two classes of rocks are closely associated, and together they occupy extensive bodies in the northern part of the county, as well as in the region about Wilderville, Selma, Kerby, and Holland. The sandstones are dark-colored, hard, fine-grained rocks. Prominent exposures are seen in the bed of the Illinois River and on the slopes near Selma. Areas of the rock in this vicinity have doubtless been buried beneath the recent alluvium of the valley. The sandstone weathers into materials which resemble the product from slates and shales, and because of its small extent has played little part in forming the soils of the county. Several ledges of hard gray limestone or marble occur on the hills west of Williams Creek, south of Wilderville, and to the east of Kerby and Holland. This rock appears to be continuous for a number of miles, but the ledges are narrow and occur in a mountainous section and have not entered materially into the formation of the agricultural soils. The rock, however, is important, as it forms a source of supply of agricultural lime.

The soils of Josephine County are classed in soil series on the basis of origin, color, topography, and structural characteristics. Each series is divided into soil types on the basis of texture. The type is the unit of soil classification.

The residual soils, together with the Rough stony land and Rough mountainous land, constitute by far the most extensive group of soils of this area. However, they include but little agricultural land, as

much of the surface is too steep or stony for cultivation. They are not adapted to irrigation because of steep topography, and also because of their elevation above the source of water supply. Moreover, many of them seem unable to retain sufficient moisture during the long dry summers to insure very profitable crops without irrigation. They are therefore mainly undeveloped and still in forest.

The residual soils may be grouped according to their origin into two general classes: (a) Soils derived from igneous rocks, and (b) soils derived from sedimentary rocks. The soils derived from the igneous materials are classed in the Olympic, Aiken, Siskiyou, and Holland series, and those derived from sedimentary rocks are classed in the Sites, Hugo, and Josephine series.

The Olympic series consists of types with brown or rusty-brown surface soils and a brown or reddish-brown subsoil. As occurring in this survey, the soils vary considerably in depth, the basic igneous rocks from which they are formed lying from 1 foot to 6 feet or more below the surface. In places the surface is strewn with small, brownish, iron-cemented pellets, and angular fragments of the parent rock are common throughout the soil profile. The subsoil tends to be slightly compact. The series occurs principally in the hills in the eastern part of the county. The topography is usually steep, and surface drainage is in places excessive. The series occurs under conditions of moderate to heavy rainfall, and the soil materials are well leached and noncalcareous. The Olympic loam is mapped in this area.

The soils of the Olympic and the Aiken series, as recognized in this survey, join along the boundary of Josephine and Jackson counties with the soils recognized in the earlier survey of the Medford Area in Jackson County as the Tolo series of soils. This apparent inconsistency is due to the fact that the Tolo series of the earlier surveys included a greater variety of soil materials, which in the later surveys have been classified in two distinct series of soils, the Olympic and the Aiken.

The Aiken series consists of types with red surface soils and a bright-red to dull-red, usually heavier and more compact subsoil. Brown iron-cemented pellets and fragments of the parent rock are common on the surface, and igneous bedrock is encountered at various depths in this survey usually at less than 6 feet. The topography varies from hilly to steep and mountainous, with surface drainage excessively developed. These soils occur under conditions of moderately heavy rainfall and are well leached of lime and other soluble minerals. They are confined mainly to the hilly sections in the eastern part of the county. The series is represented by the clay loam with a stony phase.

The types of the Siskiyou series typically have light-gray or gray surface soils with gray or brown slightly heavier and more compact subsoils. As mapped in this area, however, they include small bodies with a reddish-brown or red subsoil. The series is derived from coarse-grained granodiorite occurring extensively in the vicinity of Grants Pass. As a rule the soil materials have weathered deeply, the substratum of compact, gritty, partly disintegrated rock extending in places to a depth of 20 feet before unaltered rock is encountered. Shallow variations in which the bedrock lies within a foot of the surface are locally prominent, and outcrops of the parent

rock occur on some of the lower slopes. The series is developed on a group of relatively low hills extending north from Newhope to Hugo. Being of softer material, the rocks have weathered more rapidly than those of the surrounding mountains of greenstone and slate. The topography is very rough and broken, and the surface drainage in most places is excessive. Only one type, the coarse sandy loam, is mapped.

Closely associated with the Siskiyou soils, and derived from the same material, are the types of the Holland series. The surface soils are brown to reddish brown in color, micaceous, and friable, and in places contain small fragments of the parent rock. The subsoil ranges in color from brown or reddish brown to red, is usually somewhat more compact and heavy textured than the surface soil and frequently grades into the underlying granitic material through a zone of partly disintegrated rock. The depth of weathered soil material varies from a few inches to more than 6 feet, although local areas of shallow soil with rock outcrop are common on some of the slopes. The topography is hilly or mountainous. Drainage is well established, and the run-off is excessive on the steeper areas. The Holland coarse sandy loam, with a heavy phase, is mapped in this area.

The types of the Sites series resemble the Aiken soils in color of the surface material, structure, and mode of occurrence, but are separated from them on the basis of origin. They have red or pale-red to yellowish-red surface soils and a red or bright-red heavy-textured, compact subsoil. They are derived from the weathering of sedimentary rocks, mainly hard slates, shales, but in places sandstone. The depth of the weathered soil material varies from a few inches on the steeper slopes to 6 feet or more in smoother areas. Angular gravel and rock fragments are present in most of the types, and rock outcrops are abundant locally. The surface ranges from rolling or hilly to mountainous. Drainage is well developed, and the soils hold moisture well with cultivation. The Sites series is the most extensive upland series in the area surveyed, being widely distributed throughout the central and western parts of the county. The gravelly clay loam, with a deep phase and a stony phase, and the clay loam are mapped.

The Hugo series includes soils which are typically brown to rather dark brown in color but which include some grayish-brown to yellowish or slightly reddish brown variations. In places the surface material extends to bedrock without much change, although there is usually a definitely heavier subsoil of somewhat lighter color than the surface soil. These soils are mainly shallow, and bedrock usually occurs at a depth of 4 feet or less. Angular gravel, small spherical iron-cemented concretions, and fragments of slate or shale are common on the surface, and in places considerable stony material is distributed throughout the soil profile. The soils are derived through the weathering of sedimentary rocks, including slates, shales, and sandstone. They are mapped only on the mountain footslopes, the rougher areas being included with Rough mountainous land. A large proportion of the land is too steep to be conveniently farmed. The material is well drained and apparently noncalcareous. Only one type, the silt loam, is mapped in this survey.

The surface soils of the Josephine series are typically yellow or pale yellow, with reddish-yellow, brownish-yellow, or yellowish-red variations. The surface soils in places rest directly on the parent rock, although typically they are underlain by brighter yellow or reddish-yellow, slightly heavier subsoils. The series is derived principally from soft shales, with sandstone and slates contributing to its formation in some localities. Flat shaly fragments are common on the surface, and in places the soils grade into the underlying bedrock through a mass of broken shale. They are usually shallow, very rarely as much as 6 feet deep. They are mapped separately only in the foothills. The topography is hilly, but averages somewhat smoother than the other residual soils of the area. The Josephine soils are well drained and noncalcareous. Only one type, the clay loam, is mapped.

The soils derived from old valley-filling materials constitute a large and important group. They have resulted from the mature weathering of old unconsolidated water-laid deposits, the materials of which were originally derived from a wide variety of rocks. They occupy a large proportion of the broad valleys or basinlike areas between the mountain ranges, their position being intermediate between the recent-alluvial soils of the stream valleys and the residual soils of the hills. Most of them are developed on terraces ranging in elevation from only a few feet to 100 feet or more above the normal flow of the streams. The upper parts of the terraces merge into old alluvial fan and colluvial footslope soils, which have all the essential features of the soils of this group and are included with them. In general, these soils have a smooth surface, are fairly well drained, and are well adapted to irrigation. Because of differences in color, degree of weathering, soil profile, and character of the original materials these soils have been classified into five soil series—the Barron, Jerome, Clawson, Corning, and Kerby—of which the first is derived from material washed from granitic rocks, and the others are of mixed origin.

The soils of the Barron series are associated with the residual Siskiyou soils and closely resemble them in color and derivation. Both are typically gray in color and both have their origin in granitic materials. The Barron soils, however, occupy areas of lower, smoother topography, and are derived mainly through the weathering of unstratified old valley-filling deposits. The chief distinguishing and the most characteristic feature of the Barron soils is the presence of a brown, reddish-brown, or yellowish-brown, compact, hardpanlike layer in the subsoil, almost impenetrable in summer, but fairly permeable during the winter or when kept moist by irrigation water. The topography ranges from very gently sloping to slightly undulating. Drainage is well developed. Only one type, the Barron coarse sandy loam, is mapped in this area, but variations of brown soils with brown to reddish-brown subsoils and also of dark-colored and more poorly drained soils are locally included.

The surface soils of types of the Jerome series are gray to light brownish gray. They are low in organic matter, gritty in texture, and tend to be compact when dry. The subsoil consists of slate-colored or drab, impervious, heavy clay. The surface soil has much the same appearance as the soils of the Barron series, with which the

types are closely associated. The Jerome series is formed mainly from granitic materials, but in places waterworn gravel derived from various rocks shows that the origin is mixed. When thoroughly dry the heavy subsoil bakes into a bricklike mass which is not easily penetrated by the roots of plants. The deeper substratum is usually granitic and identical with that beneath the Barron series. The soils of this series occupy smooth and flat to gently undulating valley slopes and basinlike areas in which surface drainage is only moderately well developed and subdrainage is retarded by the hardpanlike subsoil. The series is represented in this survey by the Jerome sandy loam, with a dark-colored phase.

The Clawson series consists of types with dark-gray to black surface soils, underlain by a dark-colored compact subsoil of heavy texture, which is relatively impervious and usually somewhat mottled with iron stains. The surface soils are compact when dry, usually gritty, and high in content of organic matter. At depths ranging from 2 to 3 feet the heavy subsoil material grades into gray to dark-gray or drab material of gritty texture, containing a noticeable admixture of coarse-textured granitic material. The series is derived from old valley-filling materials which are not well stratified and which apparently represent old alluvial fan and colluvial footslope deposits. The soils occupy smooth gentle slopes, flats, and local basinlike areas, and the surface and internal drainage are usually poorly developed. The parent material appears to be mainly granitic in origin, but includes materials derived from a variety of rocks. The Clawson silt loam, with a sandy phase and a heavy phase, is mapped.

The surface soils of types of the Corning series are red and dull red to brownish red or slightly yellowish red. Waterworn gravel of mixed origin and small iron concretions are common on the surface and in the surface material of most of the types, and some contain angular fragments of igneous rocks. The subsoil is typically dull red to bright red in color, compact, usually heavy in texture, and fairly retentive of moisture, and contains rounded gravel or angular rock fragments. In some of the included materials the subsoil is very compact and partly cemented when dry. Typically the heavy subsoil passes at depths of 3 to 5 feet into friable gravelly material similar to the surface soil. In its typical development the Corning series occupies terraces lying from a few feet to 100 feet or more above the present courses of the streams. The parent material consists typically of old water-laid deposits. The surface drainage is good. Three types of this series, the gravelly loam, the gravelly clay loam, and the clay loam, with two phases, were mapped.

The types included in the Kerby series are similar to those of the Corning series in origin and topography, but differ from them in color. The surface soils are light brown or brown to yellowish brown. The subsoil is yellow, reddish yellow, or pale red, and in most areas somewhat compact. Waterworn gravel of mixed origin and small iron concretions or pellets are common in the surface soils of most of the types, and either the subsoil or substratum is invariably gravelly. Both surface and internal drainage are well developed. The series occurs under conditions of moderately heavy rainfall and is well leached of soluble minerals. Three types, the

gravelly loam with a stony phase, the loam with a stony phase, and the clay loam, are mapped in this area.

The recent alluvial soils of Josephine County, while important agriculturally, are of comparatively small extent. They occupy narrow areas along the larger streams and are composed of recent sediments deposited by flood waters or washed into the valleys by short lateral streams. The soils are of mixed origin, practically every kind of rock in the area being represented locally. In general these types have friable surface soils and permeable subsoils and substrata, with no cementation of materials or tendency toward hardpan in any part of the soil profile. They have a smooth or slightly billowy surface and lie at low elevations near the streams, consequently they are well adapted to irrigation. They are fairly well drained except in local areas. In the Rogue River Valley they are used extensively for the production of fruit and alfalfa. Two series of soils, the Columbia and the Wapato, are mapped. Of these the former is the more extensive and important.

The Columbia series consists of types with brown to dark-brown friable surface soils containing a fairly large supply of organic matter. In their typical development the soils are usually deep, the surface material in some of the types extending to a depth of 6 feet with but little change in color or structure. The topography ranges from smooth to somewhat billowy, but it is generally suitable for irrigation. Drainage is usually well developed, though some areas are subject to overflow during brief periods. Two types are mapped, the fine sandy loam, with four phases, and the loam, with two phases.

Included with the Columbia soils as mapped in this area are considerable areas of soils which normally occupy somewhat more elevated and older stream terraces and alluvial fans, and in which some modification in soil profile through weathering has taken place, with development of somewhat compact or slightly cemented subsoils. These inclusions represent a stage of development intermediate between the recent-alluvial soils and those derived from the older valley-filling materials. Owing to the desirability of reducing the number of soil types and simplifying the soil classification in this survey, they are for the most part mapped as phases of types of the Columbia series. Some of these phases could, however, with propriety have been classified with the older valley-filling materials, and in the valley of the Applegate River they join along the county boundary with similar soils, which were mapped as types of the Coleman series in the Medford Area in Jackson County.[4]

In these inclusions the subsoil is typically compact and gravelly, and in places a layer of loosely cemented gravel, varying from a few inches to 2 feet in thickness, occurs at varying depths. As a rule there is also a gravelly substratum, which is generally porous and several feet in depth. The gravel includes every kind of rock found within the area, sedimentary rocks predominating in some localities and igneous rocks in others. The soils are well to excessively drained.

The Wapato series consists of types with dark-brown, drab, or dark-grayish brown surface soils, and a dark-brown or drab impervious subsoil, which is generally mottled with yellow, rusty brown,

[4] Soil Survey of the Medford Area, Oregon. Field Operations of the Bureau of Soils, 1911.

or red. Although of mixed origin, the types in this area are derived mainly from sedimentary rocks. They occupy level areas along streams and low marginal strips at the foot of terrace slopes. Both surface and internal drainage are poorly developed, and the greater part of the series is subject to overflow. The soils are high in organic matter. Only one type, the Wapato clay, is mapped in this survey.

In the following pages of this report the soil types in the area surveyed are described in detail and their agricultural value discussed. The distribution of the types is shown on the accompanying soil map. The table below shows the actual and relative extent of the various soils:

Areas of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Rough mountainous land	201,344	41.1	Olympic loam	7,552	1.5
Rough stony land	61,760	12.6	Aiken clay loam	1,856	1.5
Columbia fine sandy loam	3,392		Stony phase	5,504	
Gravelly phase	17,984		Hugo silt loam	6,528	1.3
Stony phase	5,184	5.6	Columbia loam	1,728	
Terrace phase	448		Terrace phase	2,880	1.0
Light-colored phase	256		Poorly drained phase	384	
Josephine clay loam	27,136	5.5	Kerby clay loam	3,712	.7
Kerby gravelly loam	20,352	4.6	Sites clay loam	3,456	.7
Stony phase	2,304		Riverwash	3,392	.7
Holland coarse sandy loam	18,432	3.9	Jerome sandy loam	1,344	.6
Heavy phase	384		Dark-colored phase	1,408	
Corning gravelly clay loam	17,920	3.7	Clawson silt loam	896	
Sites gravelly clay loam	15,296		Sandy phase	896	.5
Deep phase	1,920	3.6	Heavy phase	512	
Stony phase	256		Wapato clay	1,216	.2
Siskiyou coarse sandy loam	16,192	3.3	Corning gravelly loam	1,152	.2
Barron coarse sandy loam	14,592	3.0	Placer diggings	832	.2
Kerby loam	6,336	2.2			
Stony phase	4,352		Total	489,600	
Corning clay loam	1,280				
Alluvial-fan phase	7,040	1.8			
Light-textured phase	192				

OLYMPIC LOAM.

The surface soil of the Olympic loam consists typically of light-brown to reddish-brown loam, usually containing a relatively large proportion of silty material, and extending to a depth 12 to 15 inches. The subsoil is a rather compact brown, yellowish-brown, or dull reddish brown to nearly red fine-textured loam or clay loam resting on basic igneous rock. The bedrock appears at variable depths ranging from a few inches to 6 or 8 feet. The surface in places is strewn with small, rounded, brownish-colored iron-cemented pellets and fine angular fragments of the parent rock, and much of the type contains a large percentage of angular stone fragments. These areas of high stone content are indicated upon the map by stone symbols. When wet the surface soil is rather sticky and is slightly reddish brown in color. The type merges gradually into the red soils of the Aiken series, a few areas of which, being too small to map separately, are included. In the vicinity of Grants Pass the type also includes one small area of brownish-gray soil that could properly be classed in another series if it were large enough to map.

The Olympic loam is mapped on the lower foothills in the east-central part of the county. The most prominent areas are east of

Hugo, east of Grants Pass, between Grants Pass and Murphy, and south of the Applegate River. Doubtless the type occurs within the larger areas of basic igneous hills, but the steepness of the topography precludes the possibility of agriculture, and such areas are included with Rough mountainous land.

Where the type lies at the base of hills, the surface is gently sloping. The greater part of it, however, lies on steep hillsides and mountain slopes which are poorly adapted to cultivation. The type is well to excessively drained. With thorough tillage the areas of the deeper soil which are free from stone are fairly retentive of moisture, but the stony areas are poorly adapted to agriculture.

Aside from a very small acreage near Grants Pass, which has been planted to apples, pears, peaches, and grapes, the type is still heavily forested with pine and fir. The orchards are without irrigation. The trees are making only a slow growth, especially the apples and pears, and the yields are considerably below those obtained from irrigated orchards. Peaches and grapes appear to yield somewhat better than apples or pears. Under the conditions of low summer rainfall, the type is not well adapted to dry farming, and only a small proportion of it can be successfully irrigated.

The table below gives the results of mechanical analyses of samples of the soil and subsoil of the Olympic loam:

Mechanical analyses of Olympic loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
561083	Soil	1.0	4.2	2.6	9.2	17.2	53.9	11.9
561084	Subsoil	2.1	4.6	2.8	8.7	15.4	50.2	16.2

AIKEN CLAY LOAM.

The surface soil of the Aiken clay loam, to an average depth of about 12 inches, is a red sticky clay loam containing numerous small iron-cemented pellets and small angular fragments of igneous rocks. The subsoil is a red, compact heavy clay loam or clay, carrying in most places a small amount of fine angular rock fragments. It varies considerably in depth, in places extending to several feet; in others resting on the bedrock a few inches below the surface. If tilled under the proper conditions of moisture, the soil works up readily into a mellow tilth, but it is sticky and difficult to handle when wet.

The Aiken clay loam is confined to narrow strips on the lower mountain footslopes, where it forms in many places an intermediate type between the red Corning soils and the higher lying undifferentiated soils of the Rough mountainous land. Areas of this type occur near Winona, east of Grants Pass, east of Murphy, along the base of Tennessee Mountain west of Kerby, and at Waldo.

The surface is for the most part gently sloping, as at the base of hills, but the steepness increases with elevation until the type merges into untillable areas—Rough mountainous land. Drainage is always ample, but owing to the heavy texture little damage results from erosion even in the steeper areas. In the main the type as mapped

lies favorable for cultivation, since most of the areas too steep for cultivation are shown on the map as Rough mountainous land.

Only a small proportion of this type is cleared, the greater part being forested with fir and pine. Near Grants Pass small areas have been planted to apples and pears, and elsewhere a small acreage of grain is grown for hay. The type is dry-farmed, as the topography is not favorable for irrigation. Under thorough tillage fair crops may be expected from this soil, as both the texture and structure are favorable for conserving moisture.

The price ranges from $25 to $50 an acre, depending on location, improvements, and topography.

Aiken clay loam, stony phase.—The Aiken clay loam, stony phase, which is indicated on the map by stone symbols, is generally similar to the typical material, except that it contains a profusion of subangular stones of volcanic origin scattered over the surface and mixed throughout the soil profile. Fine angular rock fragments of the same material, and small iron-cemented pellets are abundant on the surface, making the soil appear to have a lighter texture than the typical material. The larger stone fragments interfere to some extent with tillage, but are not ordinarily abundant enough to prevent cultivation, and where they have been removed the soil works up almost as readily as the typical material. This phase, however, averages somewhat more shallow than the stone-free soil, bedrock being commonly found at from 2 to 4 feet below the surface.

In a few included small areas, such as occur on Bolt Mountain, near Newhope on the Applegate River, near Placer, and near Kerby, the surface soil is somewhat darker in color than typical, ranging from dull red to dark reddish brown.

The Aiken clay loam, stony phase, although comparatively inextensive, occupies a somewhat larger acreage than the typical stone-free areas. It is confined mainly to narrow strips on the lower slopes of mountains, the upper parts of which merge into Rough stony land or Rough mountainous land. The largest body, varying from one-fourth to three-fourths mile in width, and nearly 10 miles long, lies along the base of Elk and Walker Mountains a few miles north of Grants Pass. Other areas occur near Winona, southeast of Grants Pass, and on the east slope of Grants Pass Peak.

The surface ranges from moderately sloping to steep. The lower parts of the phase are usually smooth enough for cultivation, but the gradient increases rapidly with elevation, and much of the phase is too steep to be conveniently farmed. The surface drainage is always good and is excessive on the steeper slopes.

At the present time this phase has little agricultural importance, as only a few acres are under cultivation. Most of it was originally covered with a heavy stand of fir and pine, but the greater part of this has been removed, leaving a dense growth of small trees and shrubs. Some of the included darker colored areas support a growth of prairie grasses. Because of its stony character and steeper topography the phase has a somewhat lower value than the main type. It is not adapted to irrigation and is therefore only fairly well adapted to tree fruits and the other staple crops of the area. Over much of the phase considerable work would be necessary to remove the loose stones before the land could be conveniently farmed.

Below are given the results of mechanical analyses of samples of the soil and subsoil of the typical Aiken clay loam:

Mechanical analyses of Aiken clay loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
561019	Soil	5.7	8.2	2.9	10.2	14.5	38.6	20.0
561020	Subsoil	5.4	8.0	3.0	10.0	12.6	32.0	29.1

SISKIYOU COARSE SANDY LOAM.

The surface of the Siskiyou coarse sandy loam consists of 12 to 15 inches of gray to light-gray moderately compact sandy loam containing a relatively large percentage of coarse sand and fine angular particles of granitic rock. The subsoil is a gray, light-gray, or grayish-yellow, compact coarse sandy loam to light clay loam, passing into brownish-yellow or red clay loam at an average depth of about 2 feet. The content of coarse-textured granitic particles increases with depth, the subsoil passing by degrees into partly disintegrated granite. The depth to bedrock is exceedingly variable, ranging from 2 feet or less on the steeper hills to 20 feet or more in smoother areas. In the latter case the deeper subsoil is invariably a red, coarse-textured, compact loam or clay loam.

As mapped, the Siskiyou coarse sandy loam includes small areas which differ from the typical in that the surface is brownish red or yellowish red, and the subsoil is a red compact clay loam. The topography is usually smoother than on the typical Siskiyou coarse sandy loam, the areas being confined mainly to low narrow ridges which extend out from the hills into the lower lying areas of Barron coarse sandy loam. These included areas are considered more nearly typical of the soils of the Sierra series, but because of their small extent the bodies are not separated in this survey.

The Siskiyou coarse sandy loam is confined to the comparatively low granitic hills in the vicinity of Grants Pass, the largest and most typical body occurring in the vicinity of Dimmick.

This type has a rolling or hilly surface, and the steeper areas are considerably dissected by erosion. The greater part of it, however, could be cultivated. Drainage is usually excessive, although the soil readily absorbs water. On account of the coarse texture, the type suffers from drought during the dry summer months, and the surface and elevation are unfavorable for irrigation.

In its present condition this type is of minor importance and it is not probable that much of it will be cleared until the more desirable valley types have been brought under cultivation. Most of the original heavy stand of pine and fir has been removed, and the vegetation now consists of small trees of these species with patches of oak, laurel, manzanita, ceanothus, and other shrubs. Excepting a few very small fields, this type is not farmed.

Land of this type can be bought for $10 to $25 an acre.

On account of its hilly topography and coarse texture, the greater part of it is not well adapted to dry farming, and its elevation precludes irrigation. By adding organic matter, in which the soil is

deficient, the moisture holding capacity could be increased somewhat and the soil in the smoother areas made to produce fair crops of berries and small fruits without irrigation. It is also probable that this soil would produce an excellent grade of peaches, although the yields would undoubtedly be less than those obtained on irrigated soils. Most of this type seems best suited to grazing and forestry.

The results of mechanical analyses of samples of the soil and subsoil of the type are given in the table below:

Mechanical analyses of Siskiyou coarse sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
561031	Soil	16.9	17.5	6.4	17.3	10.2	23.3	8.4
561032	Subsoil	15.4	18.6	6.9	18.8	11.3	21.7	7.4

HOLLAND COARSE SANDY LOAM.

The Holland coarse sandy loam consists of 12 to 15 inches of a brown to yellowish-brown coarse sandy loam surface soil overlying a somewhat heavier textured or slightly more compact sandy loam subsoil of the same general color. At an average depth of about 30 inches the subsoil grades into reddish-brown or red weathered material of heavy texture which passes by degrees into the underlying granite. The surface soil generally contains a quantity of brown iron-cemented pellets and a small percentage of fine granitic rock fragments. Bedrock may be encountered at any depth within the 6-foot section, and small outcrops of bedrock are common locally. Some small areas have loose granitic bowlders on the surface. Where such areas are large enough they are indicated on the map by stone symbols.

The Holland coarse sandy loam occurs west of Grants Pass, where it occupies rather large areas extending north from the Rogue River Valley to Hugo. Smaller bodies lie north of Grants Pass, near Jerome Prairie, and at various points along Williams Creek.

The topography is rolling or hilly, with many steep areas unsuitable for cultivation. In the lower areas the surface consists of gentle slopes, smoothly rounded ridges or hills, and many shallow basins or valleylike depressions. Drainage is good to excessive, but the soil readily absorbs rainfall, and little damage results from erosion.

Although rather extensive, this type is unimportant agriculturally. Less than 5 per cent of it is under cultivation, most of the remainder being cut-over land covered with brush and second-growth pine, fir, and oak. The principal crops are wheat, grapes, peaches, and cherries. Except in seasons of more than normal rainfall, small grains suffer from drought and give low yields. With proper culture grapes do fairly well, but if neglected the vines soon die or cease to bear. The peaches and cherries grown on this soil are of excellent quality, but the yields are usually low. The rough topography and the location of the type above the source of irrigation water tend to reduce its value and restrict its use to grazing or to the growing of a few dry-farmed crops.

Holland coarse sandy loam, heavy phase.—The surface soil of the Holland coarse sandy loam, heavy phase, to an average depth of 12 inches, is a brown to light-brown fine sandy loam containing a quantity of iron-cemented pellets and small angular particles of granite. In places the soil is rather heavy, approaching a loam in texture, and in other places the fine rock fragments are sufficiently abundant to make it a gravelly loam. The subsoil is a yellowish-brown compact loam extending to granitic bedrock, which is generally encountered within 3 or 4 feet of the surface. Rock outcrop and large granitic bowlders are also common in local areas, and where these are plentiful the areas have been indicated on the map by stone symbols.

The Holland coarse sandy loam, heavy phase, is confined to very narrow strips on the lower hillslopes, the most typical areas being found about 1 mile southwest of the junction of the Rogue and Applegate Rivers, and along the west side of Jerome Prairie. The surface ranges from gently sloping to steep, and drainage is in most areas excessive.

In its present condition this phase has no agricultural importance. None of it is under cultivation, and only a small proportion of it is smooth enough or sufficiently stone-free for cultivation.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the typical Holland coarse sandy loam:

Mechanical analyses of Holland coarse sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
561001	Soil	17.2	20.3	6.5	20.4	11.4	15.3	9.1
561002	Subsoil	24.1	17.3	6.2	18.7	10.1	16.4	7.4

SITES GRAVELLY CLAY LOAM.

The surface soil of the Sites gravelly clay loam consists of a red or yellowish-red clay loam, usually rather heavy, containing a quantity of iron-cemented pellets and a large percentage of slaty fragments of sedimentary rock. The depth is variable, ranging from only a few inches on the steeper slopes to 10 or 12 inches on smoother areas. The subsoil is a red gravelly clay loam or clay, the gravel content increasing with depth until the lower part is little more than a mass of broken rock fragments which rests on parent rock of slate, shale, or sandstone at depths varying from 1 to 4 feet. In general the total depth of the surface soil and subsoil averages rather shallow, although the typical soil includes very few exposures of bedrock. In a few places, notably in the vicinity of Leland, the surface material contains a large quantity of quartz fragments.

The Sites gravelly clay loam occurs in small bodies widely distributed throughout all parts of the area where sedimentary rocks are found. As mapped, it is confined to the lower mountain slopes, but its occurrence is general in the areas of Rough stony land and Rough mountainous land where derived from sedimentary rocks. Typical bodies occur near Wolfcreek and Leland, along both sides

of the Rogue River west of Grants Pass, and in the vicinity of Holland, Selma, and Waters Creek.

The topography varies from moderately sloping to steep, the upper part of the areas merging into Rough mountainous land and gradually becoming too steep for cultivation. Probably 95 per cent of the type, however, is smooth enough to permit of farming. The soil is well drained and, considering its gravelly character, is rather retentive of moisture. On some of the steeper areas drainage is somewhat excessive.

A small acreage of this type is devoted to wheat and mixed fruits, but there are no important commercial orchards. A number of fields formerly in cultivation are now idle, remoteness from transportation facilities combined with the hilly topography and gravelly character of the soil being mainly responsible for their abandonment. With good treatment satisfactory yields of fruit and small grain are obtained, but until the more easily cultivated lands of the valleys are more completely developed it is not probable that these unirrigable hill lands will be extensively farmed. Although land of this type is held at about the same price as the Sites clay loam, it has a slightly lower agricultural value.

Sites gravelly clay loam, deep phase.—Certain areas of the Sites gravelly clay loam have been mapped as Sites gravelly clay loam, deep phase. The soil profile in these areas is identical with that of the typical Sites gravelly clay loam, except that bedrock is rarely encountered within the 6-foot section. The phase also appears to average a little less gravelly than the typical soil, and in places small areas of comparately gravel-free soil are included. The phase is regarded as having a somewhat higher value than the more shallow typical areas, as it has a greater capacity for the storage of moisture. In its present condition it has little agricultural importance as most of it is still in forest. Its hilly topography precludes irrigation, but if given thorough tillage, it should be well adapted to the dry-farmed crops of the region.

Sites gravelly clay loam, stony phase.—The Sites gravelly clay loam, stony phase, which is indicated on the soil map by stone symbols, differs from the typical soil only in the content of stones. The surface is usually strewn with angular blocks and fragments of sandstone or hard slate, and usually both the surface soil and subsoil are so stony that cultivation is difficult. The type averages rather shallow, and rock outcrop is not uncommon in the steeper areas. The topography is moderately hilly to steep. Most of this phase is heavily forested. None of it is farmed. It has little agricultural value and is best adapted to forestry.

Below are given the results of mechanical analyses of samples of the soil and subsoil of the typical Sites gravelly clay loam:

Mechanical analyses of Sites gravelly clay loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
561003	Soil	3.3	5.2	2.2	6.8	7.8	45.1	29.6
561004	Subsoil	2.0	5.1	2.5	7.6	7.2	42.3	33.9

SITES CLAY LOAM.

The surface soil of the Sites clay loam consists of a deep-red to yellowish-red clay loam extending to a depth of 1 to 2 feet. The subsoil is a bright-red heavy clay loam or clay of moderately compact structure. Parent rock of hard slate, shale, or sandstone occurs at any depth below the first foot. It is usually nearest the surface on the steep slopes, and in comparatively smooth areas it may not occur within the 6-foot section. The surface soil usually carries a large quantity of iron-cemented pellets about one-half the size of a pea. The type as a whole is comparatively free of coarse material; but small rock fragments are common in the surface soil and subsoil in small areas, and in local areas bowlders are scattered over the surface. Where these areas are sufficiently extensive, however, they are mapped separately as the Sites gravelly clay loam, stony phase.

This type occurs mainly in the northern part of the county in comparatively small strips along the base of the mountains. The largest areas are just west of Hugo, along the Pacific Highway south of Wolfcreek, near Pollard and Grave, and in the northeast corner of the county.

The Sites clay loam occupies smoothly sloping hillsides favorable for cultivation. Drainage is well developed, but rarely excessive.

This type has little present agricultural importance, as the greater part is still in forest. Near Hugo a small acreage has been planted to apples, pears, peaches, and cherries. Small grains are grown in a small way, producing good yields in seasons of favorable rainfall. Under good tillage fruit, especially peaches and cherries, gives excellent returns. This soil is dry-farmed, as the surface is not well adapted to irrigation.

Land of this type is held at $25 to $100 or more an acre, depending on location and improvements.

The Sites clay loam ranks as one of the best upland soils in the county. It is productive, fairly easily handled, and adapted to all the staple crops of the area. As a means of improving the yields crops should be rotated and steps taken to eradicate the ferns which have foothold in many of the fields. This soil seems especially well suited to small fruits, such as berries, cherries, and grapes.

The table below gives the results of mechanical analyses of samples of the soil and subsoil of the Sites clay loam:

Mechanical analyses of Sites clay loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
561033	Soil	1.8	3.9	1.9	5.2	4.5	53.3	29.3
561034	Subsoil	.9	3.0	1.7	4.6	4.4	54.0	31.4

HUGO SILT LOAM.

The surface soil of the Hugo silt loam consists typically of about 10 inches of brown, friable silt loam containing a small quantity of small iron-cemented pellets and usually a large proportion of flat, angular fragments of slate and hard shale. The subsoil, to a depth of 36 inches, is a brown or slightly reddish brown compact silt loam

grading into the parent rock through a mass of rock fragments containing very little fine material. The bedrock consists of shale, slate, or sandstone, and occurs at various depths within the 6-foot section, the average depth probably being less than 4 feet. Some of the material included with this type resembles the soils of the Josephine and Sites series in color, and small areas of those soils are also included.

The Hugo silt loam is mapped in a number of small areas on the lower slopes in the northern part of the county. Typical areas lie along the Pacific Highway north of Hugo, along Grave Creek, and 3 miles northwest of Merlin. Many other smaller bodies occur along the steep hillslopes bordering Rogue River west of Merlin, and along the main highway between Love Station and Selma. A considerable proportion of the land included in Rough mountainous land throughout the central part of the county is made up of this soil type.

The surface of the lower part of most bodies of the Hugo silt loam has a favorable slope for farming, but the steepness increases with elevation rendering the upper part of the areas unsuited to cultivation. As a rule, the type grades by degrees into the undifferentiated soils of Rough mountainous land, the boundaries being arbitrarily placed where the steepness of surface renders cultivation difficult. The type is well drained, and even in the steeper areas damaging erosion is rare, as the soil readily absorbs the rainfall. Along Grave Creek, and elsewhere in small areas, this type occupies a terracelike position with a gentle slope toward the streams. It is only in such areas that the type has possibilities for irrigation.

Probably 95 per cent of the Hugo silt loam in this area is still in forest. The remainder is dry-farmed mainly to wheat, barley, cherries, and such food crops as are used at home. Wheat yields 12 to 20 bushels, with an average of about 15 bushels per acre. Most of the barley is cut green for hay, with yields ranging from 1 ton to 1¼ tons per acre. Cherries do unusually well on this type, especially in favored topographic positions with a free circulation of air and suitable moisture conditions. Mature trees in such locations yield an average of 3 tons per acre. The leading varieties are the Bing and Lambert, with some Royal Ann and Black Republican. The trees are given clean cultivation throughout the summer, although the best yielding orchard in the county, which is naturally subirrigated, receives but one plowing in the spring and no further cultivation until after the fruit is harvested.

The greater part of this type is valued only for its timber. Undeveloped tracts, suitable for farming, can be bought for $10 to $25 an acre. Ordinary farm lands sell for $25 to $40 an acre. The small cherry orchard, mentioned above, is valued at $1,000 or more an acre.

The gravel-free areas of the Hugo silt loam are retentive of moisture and seem well adapted to a wide range of crops. Certain hillside areas in covelike positions, which are practically immune from damage by frosts, seem especially well suited to cherries. It is also probable that grapes would do well on this type of soil. The more gravelly areas are apt to be droughty and not well suited to dry farming. Owing to the rough topography, the greater part of this type is best adapted to forestry and grazing.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the Hugo silt loam:

Mechanical analyses of Hugo silt loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
561029	Soil	1.7	1.7	0 8	3.3	9.4	68.7	14.4
561030	Subsoil	3.3	4.9	2.1	6.1	11.1	59.5	12.5

JOSEPHINE CLAY LOAM.

The surface soil of the Josephine clay loam consists of yellow, pale reddish yellow, or yellowish-red clay loam, with an average depth of about 12 inches. The subsoil is a reddish-yellow or pale-red clay loam or clay, which extends to depths of 4 to 10 feet, where it grades into partly disintegrated shale. Both the surface soil and subsoil contain a quantity of gray or brownish-yellow shale fragments and the type as mapped includes small areas of typical shale loam. Notwithstanding the content of shale, the structure of the soil and subsoil is moderately compact, and the type has a relatively high moisture-holding capacity. In places this type grades into the Hugo silt loam, and as mapped includes small areas in the northern part of the county in which the surface soil is of somewhat more brownish color than is typical and represents a gradation toward the soils of the Hugo series. In other places it is rather red and bears a close resemblance to the Sites clay loam. Rock outcrop and loose bowlders are not common on the surface, but rock fragments constitute a considerable proportion of the soil mass.

The Josephine clay loam is extensively developed in all parts of the county where sedimentary rocks are found. As mapped, it is confined to the lower hills, but it is the dominating type of soil included in Rough mountainous land in the south-central part of the area surveyed. The largest body, beginning at Kerby, extends north over the low divide to Deer Creek. Numerous smaller bodies occur on the slopes leading down to the tributaries of Deer Creek, and along the road between Wilderville and Wonder. Other fairly extensive bodies occur near the southwest corner of the area surveyed, along Williams and Wolf Creeks, and about 3 miles west of Merlin.

The Josephine clay loam occupies the lower or smoother slopes of the mountainous region in which it occurs. It also occupies a few smooth, narrow table-lands and small basinlike depressions or mountain valleys. The greater part of the type is smooth enough for farming, although some of the higher areas are too steep. Drainage is well developed and somewhat excessive in the steeper areas, yet there is little damage done by erosion, as the shaly character of the soil enables it to absorb the rainfall readily, and subdrainage is somewhat retarded.

This type of soil is of little agricultural importance at present, as practically all of it is still in forest or is cut over and grown up to brush. A few small fields of grain are grown, principally for hay, but the cultivated acreage is probably less than 1 per cent of the total acreage of the type.

Land of this type can be bought for $10 to $25 an acre, depending on location, topography, and timber growth.

As is the case with the other residual soils of the area, the hilly topography and elevation above the source of water preclude irrigation on most of the type and confine its use to dry farming. Under the prevailing conditions of low summer rainfall the land suffers from drought, and only with exceptionally favorable seasons or with exceptionally good farming can more than moderate yields be expected. In time it may be possible to water some of the smooth lower slopes, and in case this is done the land should be found well adapted to a wide range of crops.

The table below gives the results of mechanical analyses of samples of the soil and subsoil of the Josephine clay loam:

Mechanical analyses of Josephine clay loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
561007	Soil	3.7	5.6	3.4	16.1	15.8	32.3	23.4
561008	Subsoil	4.1	6.0	3.2	16.4	14.2	26.4	30.1

BARRON COARSE SANDY LOAM.

The surface soil of the Barron coarse sandy loam, in its typical development, is a light brownish gray or yellowish-gray, moderately compact coarse sandy loam, with an average depth of about 12 inches. It is deficient in organic matter, although the first inch usually contains enough to give the surface a slightly browner color than that immediately beneath. The subsoil, to an average depth of 18 inches, is a rusty-brown or dark reddish brown, semicemented, compact clay loam containing coarse grains of quartz and feldspar. Below this, and extending to a depth of 3 feet or more, the material is a rusty-brown coarse-textured clay loam, somewhat cemented and very compact. While true cemented hardpan is not encountered in this type, a condition closely approaching it is found in many places. However, unlike the consolidated hardpans due to accumulations of iron or lime, the compact layers in this type do not entirely restrict the downward movement of water during the winter months. At this season the heavy subsoil becomes thoroughly saturated and the type remains water-logged for several months.

Included with this soil type are a number of small areas of soils which depart somewhat in color, drainage, or other characteristics from the typical material, and which, had they been of greater extent, would have been mapped as a separate series of soils. In some of these local inclusions the surface soil ranges from yellowish brown to reddish brown and the subsoil from pale yellowish red to red.

The most conspicuous variation consists of local areas of darker colored soils with somewhat less well developed drainage, which are derived mainly from granitic material but contain materials from other sources to a greater extent than the typical Barron material. In these areas the surface soil has a rather wide range in texture.

Usually it consists of a dark-gray to dark brownish gray or dark grayish brown coarse sandy loam containing a quantity of fine angular particles of granite, resting on a subsoil of brown, brownish-gray, or drab, compact coarse sandy loam, which grades into a plastic mottled drab, yellow, and gray clay loam carrying coarse granitic sand. The surface soil is deficient in organic matter, and on drying becomes hard and compact. In places the heavy substratum dries out into a loosely cemented mass which offers considerable resistance to the passage of water and penetration by plant roots.

The soil in the finer textured areas is a dark-gray friable fine sandy loam extending to an average depth of about 12 inches, where it grades into a dark-gray or drab compact loam mottled with yellow or brown. When thoroughly dry, the subsoil becomes hard and brittle, but is somewhat less firmly cemented than the subsoil of the coarse sandy loam variation.

The typical Barron coarse sandy loam occupies rather extensive areas in the Rogue River Valley near Grants Pass. Other bodies occur at Williams and in the vicinity of Merlin. The soil occurs in the troughs of the larger valleys, on the lower parts of old alluvial fans, and as narrow strips extending well up into the hills along the courses of minor, intermittent streams.

The dark-colored inclusions are inextensive and unimportant. Two small areas occur within the city limits of Grants Pass, others lie 3 to 7 miles south and west of this point, and another about 1 mile southwest of the junction of the Rogue and Applegate Rivers.

The topography of the larger areas of this type ranges from smoothly undulating to gently rolling, and in most places is favorable for irrigation. The fans and minor valleys have a uniform gentle slope in the direction of streams. In places the type occupies flat or basinlike areas, with poor surface drainage. In the main, however, the surface drainage is good. Subdrainage is usually restricted by the cementation in the subsoil.

Although the Barron coarse sandy loam is relatively extensive, it is of minor agricultural importance. Probably 10 per cent of it has been cultivated at some time in the past, but the failure to secure water for irrigation and the uncertainty of obtaining profitable yields by dry farming have resulted in the abandonment of many fields. At the present time probably not more than 2 or 3 per cent of the type is being cultivated, most of the remainder being covered with a brushy growth consisting mainly of oaks, manzanita, madrone or laurel, and young pines and firs. Corn and small grains are grown in a small way, with yields ranging from 5 to 15 bushels per acre. Spring-sown grain is frequently a failure. A small acreage of apples and pears has been planted, but most of the orchards are poorly cared for and unthrifty in appearance. For a few years some of the trees were irrigated, and it is said that during this period there was a satisfactory growth, but during the present year (1919) no water has been applied, and the result was a low yield of fruit of inferior quality. At the present time none of this type is irrigated, although steps are being taken to bring several hundred acres under water in the near future.

The Barron coarse sandy loam ranges in price from $10 to $20 an acre for undeveloped tracts, and from $20 to $30 an acre for partly cleared tracts in the vicinity of Grants Pass.

The Barron coarse sandy loam is not adapted to dry farming. Irrigation is the first requirement for success. The soil is deficient in humus and would be benefited by liberal applications of barnyard manure or by the turning under of alfalfa or clover. The results obtained in small garden tracts under irrigation indicate that when the land has been improved as recommended fair to good results can be obtained with most of the crops grown in the area. The soil is easily worked, but is not retentive of moisture, and will require somewhat more water than soils of heavier texture. It is probably best adapted to vegetables.

The results of mechanical analyses of samples of the soil and subsoil of the Barron coarse sandy loam are given in the following table:

Mechanical analyses of Barron coarse sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
561095	Soil	16.2	21.2	7.6	19.8	11.2	18.2	6.0
561096	Subsoil	14.8	20.9	7.2	20.5	12.2	18.5	6.0

JEROME SANDY LOAM.

The surface soil of the Jerome sandy loam is a gray or light-gray to light brownish gray friable sandy loam of low organic content, and containing a quantity of coarse sharp granitic sand. At an average depth of about 12 inches the soil passes abrutly into drab, compact, impervious material of heavier texture, which continues to a depth of 6 feet or more, where it may or may not rest on partly cemented waterworn gravel. In surface soil the type resembles the Barron coarse sandy loam, with which it is closely associated, but it differs from that type in having a heavier textured subsoil. In places a thin deposit of waterworn gravel is found on the surface. When thoroughly dry the subsoil bakes into an exceedingly hard mass which is not easily penetrated by the roots of plants.

This type occurs in a few small areas, the most prominent of which are found on the highway 2 to 4 miles southwest of Grants Pass. A somewhat larger area lies about 2 miles south of Williams in the southeastern part of the county.

The surface of the greater part of the type is smooth or gently undulating. The area near Williams extends a short distance into the foothills, where it merges into residual soils of granitic origin. Here the surface slopes gently toward the lower part of the valley. The topography of the entire type is favorable for irrigation. Surface drainage is only fairly well developed, while the internal drainage is decidedly inadequate.

As mapped in this area, the type includes small strips in the lower foothills in which the surface soil is a heavy fine sandy loam, brownish gray in color, and the subsoil is a drab impervious clay loam or clay mottled with yellow and gray.

In its present condition this type has little agricultural importance, as less than 5 per cent of it is used for cultivated crops. The type was originally covered with a fair stand of fir and pine, but most of this has been removed, and the covering now consists of small oaks, pines,

and chaparral. Attempts to farm this soil type have not proved profitable, as is indicated by a number of abandoned fields. Some apple and pear orchards have been started, but the trees never made a satisfactory growth, and at the present time most of them are either dead or badly stunted. The land is not adapted to dry farming, and water is not yet available for irrigation. Before much of the type is utilized for agriculture, it will be advisable to make the subsoil more pervious to water and plant roots by subsoiling and providing better conditions of subdrainage.

Jerome sandy loam, dark-colored phase.—The surface soil of the Jerome sandy loam, dark-colored phase, consists of 10 to 12 inches of dark-brown loam, containing a large proportion of waterworn gravel and fine angular fragments of rock of mixed origin. The subsoil to a depth of 36 inches is a dark-drab, greenish-gray, or dark-brown, heavy, sticky, impervious clay, containing considerable fine gravel. In places both the soil and subsoil contain waterworn cobbles of mixed origin. In some localities the surface is slightly reddish brown, and the deeper subsoil is a gray or light-drab impervious clay, showing considerable mottling of yellow and brown. The surface is fairly friable when moist, but becomes very hard and intractable on drying. The subsoil, when thoroughly dry, bakes into a bricklike mass resembling hardpan and offering about the same resistance to the downward passage of moisture and plant roots.

This phase of the Jerome sandy loam is of limited extent, occurring mainly in a few narrow strips near Merlin and Kerby and between Kerby and Holland. Other small areas are mapped west of the West Fork of the Illinois River in the southern part of the county.

The areas of this phase occupy treeless or sparsely forested glades along minor intermittent drainage ways. The surface features range from rather steep terrace slopes to nearly level flats. Surface drainage is good, as practically every area is crossed by one or more channels that carry water after rains. The underdrainage, however, is restricted by the compact, impervious subsoil.

This phase of the Jerome sandy loam ranks as an inferior soil and has no agricultural importance at present. Attempts to farm it without irrigation have not been successful, and only a few acres are now under cultivation. The soil requires careful handling, for if plowed when too wet the surface runs together and puddles and on drying bakes into clods which are difficult to pulverize. Adding organic matter should prove beneficial, and improving the underdrainage is essential to success.

The table below gives the results of mechanical analyses of samples of the soil and subsoil of the typical Jerome sandy loam:

Mechanical analyses of Jerome sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
561015	Soil	4.5	13.0	6.7	24.9	16.8	26.7	7.5
561016	Subsoil	3.1	5.5	3.0	10.7	7.2	25.4	45.1

CLAWSON SILT LOAM.

The surface soil of the Clawson silt loam, to an average depth of about 12 inches, consists of a dark-gray to black, smooth-textured silt loam, containing a fairly large supply of organic matter. The upper subsoil is a compact, sticky, silty loam or clay loam, which varies in color from black to mottled brown, yellow, and drab. This usually overlies a drab compact clay with rusty-brown or yellowish mottlings. At an average depth of about 30 inches the clay becomes lighter in color and decidedly gritty in texture from the presence of coarse granitic material. Under thorough cultivation the soil remains moist throughout long periods of drought, but if uncared for the surface bakes and becomes intractable.

The Clawson silt loam is small in extent. The largest area lies within the city of Grants Pass, and smaller areas occur about 2 miles west of Grants Pass and on Jerome Prairie.

The surface is nearly level, and drainage is poorly developed. The type is water-logged throughout the winter and spring, and in some of the areas the water table stands at less than 3 feet below the surface until well into summer. This condition is due to the impervious character of the underlying strata, which greatly restrict the movement of both soil water and air.

This type of soil has very little agricultural importance. Only a small proportion of it is cultivated, although the greater part is cleared and in native grasses that provide excellent grazing during the spring and fall. Corn is the principal crop, the yields ranging from 20 to 35 bushels per acre. At present none of the land is irrigated. The price ranges from $50 to $200 an acre or more, depending on location of the particular tract with respect to Grants Pass.

The greatest need of this soil type is underdrainage. When thoroughly drained and brought under irrigation it should be especially well suited to the production of corn, clover, and grasses. The application of superphosphate at the rate of 200 pounds per acre is recommended for clover and grass.

Clawson silt loam, sandy phase.—The surface soil of the Clawson silt loam, sandy phase, consists of 10 to 15 inches of a dark-gray to nearly black, friable sandy loam or loam containing sufficient coarse sand to make it rather gritty. The subsoil is variable and is usually made up of several distinct strata. The surface soil commonly passes abruptly at a depth of about 12 inches into black sticky sandy loam or loam, which grades into dark brownish gray or drab, gritty clay mottled with yellow at a depth of 26 to 30 inches. The substratum is a mottled gray and yellow clay containing a quantity of coarse granitic sand, or gray soft particles of feldspar. The soil is high in organic matter and is retentive of moisture.

This phase of the Clawson silt loam usually adjoins soils of granitic origin, and although in places it contains some basic igneous materials it is derived principally from deposits washed in from granitic rocks. It is confined mainly to a few small areas in the vicinity of Grants Pass, on Jerome Prairie, and near the mouth of the Applegate River.

The phase occurs on level flats, on gently sloping areas at the foot of hills, and along some of the smaller streams. In places the surface is too flat for good drainage, and the compact, impervious sub-

soil so retards the internal movement of water, even in the sloping areas, that the soil, once saturated, is slow in drying out. A few small areas have been tile drained.

Owing to its small extent, this phase of the Clawson silt loam is unimportant agriculturally. Less than one-fourth of it is under cultivation. The remainder is in native grasses and used for pasture, or is sparsely forested with fir, pine, and dwarfed oaks. The leading crops are alfalfa, corn, oats, and wheat. Pear trees have recently been planted on a small acreage and, where drainage conditions are favorable, have made a satisfactory growth. Alfalfa yields 2 to 4 tons per acre; corn, 20 to 25 bushels; oats, 20 to 30 bushels; and wheat, about 20 bushels per acre.

This soil is farmed mostly without irrigation. Fall plowing is the rule, as the land is rather late in drying out in the spring. It is not sold separately, but is held with other types at $25 to $50 an acre. The land is greatly in need of tile draining, and when so improved would be well adapted to the staple crops of the region.

Clawson silt loam, heavy phase.—The surface soil of the Clawson silt loam, heavy phase, is a dark-gray or drab to black, clay loam, usually rather silty in texture, extending to a depth of 12 to 24 inches. In some of the lower areas the soil tends toward an adobe structure on drying. The subsoil is a mottled drab plastic clay loam grading into lighter colored material with increasing depth. At an average depth of about 30 inches this gives way to a gray, gritty, sticky clay loam, which usually terminates at 6 to 10 feet in coarse granitic rock. In its virgin state, or if left uncultivated during the summer months, the surface becomes very hard, and cracks extending to the subsoil are formed. If cultivated when in the proper state of moisture the soil breaks up into a mellow tilth, but if plowed when wet it forms into clods which on drying become very hard and brittle.

This phase occurs only in small areas in widely separated parts of the county. The most prominent ones occur within or near the city of Grants Pass, at the base of Bolt Mountain on Jerome Prairie, and on the west side of the Illinois River. A narrow strip bordering an intermittent stream is crossed by the Pacific Highway about 2 miles east of Merlin.

This soil is composed of old alluvial and colluvial deposits, the surface material being derived largely from greenstone and other basic igneous rocks, and the underlying strata being composed mainly of granitic materials. The area west of the Illinois River is composed in part of the product from weathered slate and sandstone.

The larger areas have a flat surface, and the bodies lying along drainage ways and at the foot of hills have a gently sloping surface. Drainage is inadequate in all the areas, since the impervious subsoil retards the downward movement of water. Practically all of the phase lies favorably for irrigation.

Parts of the Clawson silt loam, heavy phase, have been farmed, but at present this soil is of little agricultural importance, none of it being cultivated. The areas are treeless, but support a good growth of native grasses and are utilized for pasture. Practically all of the soil is in need of underdrainage. If tile drained and thoroughly cultivated, this soil should be well adapted to corn, small grains, and grasses.

The table below gives the average results of mechanical analyses of samples of the soil and subsoil of the typical Clawson silt loam:

Mechanical analyses of Clawson silt loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
561045, 561047	Soil	1.0	2.7	1.4	7.6	24.3	51.7	11.5
561046, 561048	Subsoil	2.2	4.1	1.5	8 9	25.9	41.7	15.5

CORNING GRAVELLY LOAM.

The Corning gravelly loam, as mapped in this area, varies somewhat from the typical soils of the Corning series, but owing to similarity in color and profile, and to the small area covered, it has been included with the Corning soils in this survey. It represents an inclusion of weathered alluvial-fan and alluvial-footslope materials derived mainly from basic igneous rocks of the adjacent hills.

The surface is less flat, the included gravel or rock fragments are more angular than in the typical Corning, and the waterworn siliceous gravel of the latter is generally wanting. Also the materials are less well-assorted and stratified. In origin, mode of formation, profile, and topographic position the type corresponds to the alluvial-fan phase of the Corning clay loam.

The surface soil is a dull-red heavy loam containing a large quantity of angular gravel. At an average depth of about 12 inches this passes into a brighter red, compact gravelly clay loam resting on mottled drab and yellowish-red gravelly clay at about 2 feet in depth. This layer is usually very compact and when dry is frequently cemented with iron. When thoroughly saturated the cemented layer softens and apparently has little effect on the downward movement of water. During the summer, however, it has the characteristics of a hardpan and forms a serious obstacle to root development. In places the compact layer extends to a depth of 3 feet or more; in other places it is only 6 or 8 inches thick and is underlain by pale-red or yellowish-red gravelly clay of more pervious structure. The gravel is derived from basic igneous rocks, and the fragments rarely exceed 3 or 4 inches in diameter.

The Corning gravelly loam occurs in a few narrow gently sloping to steeply sloping areas along the base of the hills near Grants Pass, and on high, smooth terraces along the Applegate River in the vicinity of Murphy and near Bolt Mountain, and about 1½ miles east of Merlin. The surface drainage is well developed. In the vicinity of Grants Pass a part of the type lies 300 to 500 feet above Rogue River, an elevation too great for profitable irrigation. Some of the other bodies lie favorably for irrigating, though as yet little water has been made available for this purpose.

Owing to its small extent this type is of little importance. About one-fourth of it is cultivated, and the remainder is sparsely covered with brush and native grasses. Near Grants Pass a small acreage is devoted to apples, pears, and peaches. The orchards are without irrigation, and while the trees have made a fairly satisfactory growth, the yields of fruit have been light. A few small vineyards

have been planted, but later neglected, and some have been abandoned. There is one small field of irrigated alfalfa near Murphy. No leveling has been done on this tract, and the water is poorly distributed. The yield ranges from 2 to 4 tons per acre.

The Corning gravelly loam has about the same range in price as the Corning clay loam, alluvial-fan phase. It is adapted to the same crops and is equally in need of irrigation. The suggestions made for the improvement of the Corning clay loam, alluvial-fan phase, are applicable to the Corning gravelly loam.

The table below gives the results of mechanical analyses of samples of the soil and subsoil of the Corning gravelly loam:

Mechanical analyses of Corning gravelly loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
561073	Soil	3.4	6.0	2.9	11.3	19.7	41.7	14.9
561074	Subsoil	2.6	5.6	2.7	11.1	22.1	36.2	19.6

CORNING GRAVELLY CLAY LOAM.

The surface soil of the Corning gravelly clay loam, in its typical development, consists of 12 inches of a dull-red clay loam containing 20 to 40 per cent of mixed waterworn gravel. The subsoil, to a depth of many feet, is a red, compact gravelly clay loam or clay. The surface soil generally contains a large quantity of rusty-brown iron-cemented pellets about one-half the size of a pea, and in places accumulations of this ferruginous material has caused a slight cementation in the subsoil. Locally some of the material included with this type has a rather light loamy texture, and is somewhat more friable than typical.

Certain areas have a large content of bowlders ranging from 6 inches to 1 foot or more in diameter. These stony areas are indicated upon the map by stone symbols. Usually the stones occur only on the surface, but in places they are irregularly distributed throughout both the soil and subsoil. For the most part they consist of hard, resistant rocks, in which quartzite, granite, and slate predominate. In places, as along Rough and Ready Creek in the southwestern part of the area surveyed, the bowlders are so numerous as to make the land nonagricultural; in other places they interfere more or less with cultivation.

The Corning gravelly clay loam is widely distributed throughout all of the larger valleys of the area. The largest developments occur in the Illinois River Valley south of Kerby and on the south side of the Rogue River below its junction with the Applegate River. Other important bodies lie just southeast of Wilderville, near Merlin, and along Grave Creek in the vicinity of Leland. Small areas occur near Provolt.

This type is found on old high terraces skirting the edge of the valleys, and in places is 200 or 300 feet above the streams. It includes some fairly level terrace remnants, as in the areas lying well out in the Illinois Valley and in some of those near Wilderville and west of the mouth of the Applegate River. In other places it extends

a short distance up smooth slopes, the surface nearly always being uniform and regular. In places the boundaries between this type and the related Kerby soils are marked by sharp terrace slopes; in others both series occur on the same general level and are distinguished only by differences in color. For the most part, the type has excellent surface and internal drainage, although there are small local areas in which the compact subsoil obstructs the downward movement of water and makes artificial drainage desirable in case of irrigation.

Although this type is fairly extensive, it has at present little agricultural importance, as less than 5 per cent of it is tilled. The greater part is still covered with a good stand of fir and pine mixed with a scattering growth of oak. Alfalfa, wheat, corn, and timothy and other grasses, in the order named, are the principal crops. The wheat and corn are grown without irrigation and give fair to good yields, depending on the season. Under irrigation alfalfa and the grasses give excellent returns.

The Corning gravelly clay loam is valued at $20 to $50 an acre, depending on location, improvements, and timber growth.

Under irrigation this soil is well adapted to the production of general farm crops, but under the prevailing conditions of scant summer rainfall it is not well suited to dry farming. The surface of the greater part of the type is favorable for irrigation, but as yet a water supply has not been developed for the higher terraces.

The results of mechanical analyses of samples of the soil and subsoil of the Corning gravelly clay loam are given in the following table:

Mechanical analyses of Corning gravelly clay loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
561039	Soil	5.6	11.0	3.6	9.2	11.4	39.2	20.0
561040	Subsoil	2.1	7.5	3.6	10.3	12.4	37.2	26.9

CORNING CLAY LOAM.

The Corning clay loam consists of a dark-red or bright-red clay loam, containing a quantity of small iron-cemented pellets, underlain by a bright-red heavy clay loam or clay at an average depth of about 12 inches. The iron-cemented pellets are present here and there in the subsoil, but are not so numerous as in the surface soil. The deposits from which this type is derived are usually 20 feet or more in depth and in places contain gravelly strata of varying thickness.

This soil type is of very small extent and generally occurs within larger areas of the Corning gravelly clay loam. Small bodies lie in the Illinois River Valley near the Floyd School and in several places along the lower course of the Rogue River.

The surface is nearly level and favorable for irrigation. Both the surface and internal drainage are satisfactory.

At present the Corning clay loam has no agricultural importance, as none of it is tilled. It is adapted to the same crops as the Corning gravelly clay loam and has practically the same agricultural value.

Corning clay loam, alluvial-fan phase.—The alluvial-fan phase of the Corning clay loam represents a variation from the typical soil, in that the parent material consists mainly of local alluvial-fan and footslope deposits rather than old valley-filling deposits. It consists of about 12 inches of pale-red to bright-red clay loam, overlying red compact clay loam or clay of somewhat lighter red color, and in places grading into mottled yellowish-red and drab semicemented compact clay.

In most of the areas covered by this phase the surface and subsoil materials contain a quantity of gravel and rock fragments. In places the stones are so numerous on the surface as to interfere with tillage, although the greater part of the stony areas can be prepared for cultivation at little expense for clearing off the stones.

Included with this phase are a number of areas in which the soil material is comparatively free from stones but contains much fine angular gravel throughout the 6-foot section. The fragments rarely exceed 2 or 3 inches in diameter.

The surface soil is rather plastic when wet, but if plowed at the proper time a mellow seed bed is easily prepared. Although the subsoil is compact and slightly cemented, it does not greatly retard the development of plant roots or the penetration of water.

The Corning clay loam, alluvial-fan phase, is mapped in a number of areas in widely separated parts of the county. The most important areas occur on the lower foothill slopes near Grants Pass and along the Pacific Highway east of Merlin and Hugo. Other areas occupy terraces and slopes along the Applegate River, near Winona, in the vicinity of Merlin and Pleasant Valley, and in the extreme southwestern part of the area surveyed.

This phase generally occurs as moderately sloping areas extending along the base of hills, as steeply sloping fans, or as smooth, nearly level, high terraces. In places these three types of topography are distinct and represented by areas of considerable size, while in other localities the terraces and fans merge into the foothill areas with no distinct line of separation. The slope is ample for good surface drainage, yet is rarely too steep to be conveniently irrigated. Owing to the dense compact horizon in the subsoil, the underdrainage is restricted, although this is not so detrimental as on the soils of flatter topography.

The stony areas of this phase are somewhat more important agriculturally than the stone-free part of the phase. However, only a slightly greater proportion of the land is cultivated, the same crops being grown with about the same success on the different kinds of land. Owing to its small extent this phase of the Corning clay loam is of minor agricultural importance. Perhaps 25 per cent of it is under cultivation and the rest is covered with pine, fir, mazanita, madrone, laurel, ceanothus, and small oaks. Alfalfa is the principal crop on the areas near Murphy, and grapes are of most importance in the vicinity of Grants Pass. Alfalfa is grown only under irrigation, with yields averaging between 3 and 4 tons per acre. The grapes are unirrigated and given clean cultivation. They yield an average of about 300 crates per acre. A small acreage of corn and wheat is produced on this soil, but without irrigation the yields are low. Apples, cherries, and pears are produced without irrigation.

Undeveloped land of this phase can be bought for $25 to $50 an acre; irrigated hay lands for $75 to $100; and well-developed lands are held at $300 to $500 an acre.

Although moderate success has been obtained in growing fruit trees on this phase without irrigation, the land can not be said to be well adapted to dry farming. With irrigation the soil should be suited to the production of apples, pears, peaches, and grapes, and it is one of the most desirable of the old valley-filling soils for this purpose. It seems especially well adapted to grapes. The leading varieties are the Flame Tokay and the Malaga. Although the soil is retentive of moisture, the long dry summers greatly reduce the yields and make irrigation necessary for best results. Sowing vetch in the fall and plowing it under the following spring before the last rains should prove beneficial in increasing the supply of organic matter and making the soil more retentive of moisture. This practice is recommended both for dry-farmed and irrigated fields, as the soil is deficient in humus and in consequence has a tendency to form clods unless it is plowed when moisture conditions are just right.

Corning clay loam, light-textured phase.—The Corning clay loam, light-textured phase, consists of 1 to 12 inches of red friable loam underlain by red clay loam to a depth of 6 feet or more. Iron-cemented pellets are common in both the surface soil and subsoil, giving the phase in places the appearance of being rather coarse in texture. Gravel is rare on the surface, but is frequently encountered in the deeper subsoil.

This phase of the Corning clay loam is confined mainly to one small body about 9 miles west of Grants Pass. The surface is nearly level, and drainage is good. Only a small acreage is cultivated. The same crops are grown and about the same yields are obtained as on the gravelly clay loam member of the series. This soil is easily tilled and is considered slightly superior to the gravelly clay loam.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the typical Corning clay loam:

Mechanical analyses of Corning clay loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
561091	Soil	5.2	13.3	4.8	12.7	8.3	29.0	26.9
561092	Subsoil	3.4	10.2	4.1	11.7	8.9	30.1	31.7

KERBY GRAVELLY LOAM.

The surface soil of the Kerby gravelly loam, in its typical development, consists of 8 to 12 inches of light-brown or yellowish-brown friable loam, containing a large quantity of waterworn gravel. The gravel ranges in size from one-half inch or less in diameter to cobblestones 6 inches or more in diameter. It represents a wide variety of rocks, including hard slate, granite, quartzite, and basic igneous rocks. In most places the sedimentary rocks predominate. The surface material usually contains a large quantity of rusty-brown iron cemented pellets, making the texture seem lighter than the mechanical analysis would indicate. The humus content is low and in virgin areas rarely influences the material below the surface inch.

The subsoil is a brownish-yellow, yellowish-red, or pale-red compact gravelly clay loam, grading at an average depth of about 3 feet into a more gravelly mass of lighter textured and more friable material, which continues with but little variation to a depth of several feet. The upper subsoil is invariably compact and is usually feebly cemented with ferruginous material. This condition is quite noticeable in virgin or dry-farmed areas; under irrigation the cemented layer appears to soften and is not a serious obstacle to drainage or the development of plant roots.

There have been included with this type as mapped in this survey a number of small soil areas which are similar in color but differ from the typical material in origin and in profile. These areas, which are of local occurrence, have been derived mainly from weathered old alluvial-fan and foot slope deposits at the base of some of the hills and ridges formed of basic igneous rocks, from which the material has been washed. In this variation the surface soil, to an average depth of 12 to 15 inches, is a brown, light-brown, or slightly yellowish brown, friable loam containing a large percentage of angular fragments of igneous rocks. The subsoil, to a depth of several feet, is a brown, pale reddish brown, or yellowish-brown, heavy loam or clay loam containing 50 to 75 per cent of angular rock fragments 2 to 6 inches in diameter. The gravelly subsoil is very compact, and in places it is partly cemented when dry. When wet, the surface soil frequently has a distinctly reddish cast, but this color is lost on drying and the surface appears brown or slightly yellowish brown.

The Kerby gravelly loam is widely distributed throughout all of the larger valleys, where it occurs mainly as elongated strips on high marginal terraces. The largest areas are in the Illinois River Valley and along Deer Creek in the southern part of the county. Many smaller bodies are mapped at the base of the foothills and within the valleys of the Rogue and Applegate Rivers, along Williams Creek, and in the vicinity of Merlin, Heffling, and Hugo. A few small areas are also mapped along the tributaries emptying into Deer Creek from the north, along Reeves Creek near Kerby, and along Wolf, Coyote, and Salmon Creeks in the northern part of the county.

The included variation derived from igneous rocks occurs in a number of small bodies in the western half of the area surveyed. Several are found in the vicinity of Grants Pass, along the Applegate River near Murphy, Davidson, and Bolt Mountain, and in various places along the Pacific Highway between Grants Pass and Hugo, and a long, narrow strip occurs at Winona.

The Kerby gravelly loam in its typical development is derived from water-laid materials which were deposited as an extensive mantle over the valley floors, but which subsequently have been largely removed by erosion, leaving only fragmentary terrace remnants at considerable elevation above the present level of the streams. Most of the material has its source in a variety of rocks, but some of the smaller areas of local occurrence are derived mainly from sedimentary rocks. The surface is either nearly level or has a gentle slope in the direction of the streams, a large proportion of the land needing little leveling to fit it for efficient irrigation. A number of shallow channels cross the type, giving it good, natural drainage.

The Kerby gravelly loam is only locally important agriculturally, as not more than 20 per cent of it is under cultivation. A number

of fields that have been farmed in the past have been abandoned because of lack of water for irrigation. Most of the type originally supported a good stand of pine and fir timber, but the greater part of this has been removed and a new growth of oak, ceanothus, manzanita, and other small shrubs is taking its place, though there are occasional patches of native grasses which provide a small amount of spring and fall grazing.

Along the Applegate River, where a small acreage is being watered, alfalfa, corn, apples, and cherries are giving good returns. In a few other localities small areas are utilized for the production of apples, but little water has been developed for irrigation, and the trees are making a slow growth. Alfalfa constitutes a crop of considerable local importance in the vicinity of Holland. Corn, wheat, barley, potatoes, and vegetables are grown locally in various other parts of the area. The corn and small grains are dry-farmed, but the other crops are grown with irrigation. Part of the grain is cut green for hay. The alfalfa is usually cut three times, and yields 3 to 4 tons per acre per season in addition to furnishing two to four weeks of fall pasture. Corn yields 20 to 30 bushels per acre, small grains 20 to 35 bushels, and potatoes 100 to 150 bushels per acre. In the few cases where small grains have been grown with irrigation, excellent yields have been obtained. The wheat grown is principally winter wheat, sown the latter part of September. Spring wheat is only occasionally successful, as its yield is dependent on early summer rains, which are usually light and uncertain. The type is handled and fertilized in the same way as the Kerby loam.

Well-developed areas of this type sell for $30 to $75 an acre, depending on improvements, facilities for irrigation, and distance from railroads. Undeveloped tracts at some distance from markets, but lying favorably for irrigation, can be bought for $25 to $35 an acre.

The Kerby gravelly loam is a desirable soil type where water is available for irrigation, but it is not well adapted to dry farming. Its water-holding capacity could be considerably improved by plowing under alfalfa or clover or by applying barnyard manure. The soil is best suited to a type of farming that includes dairying or the raising of hogs.

Kerby gravelly loam, stony phase.—The stony phase of the Kerby gravelly loam differs from the typical material in the content of stone. The surface soil usually contains enough bowlders from 6 to 12 inches in diameter to interfere seriously with cultivation. The stones, embedded in friable yellowish or reddish loam, usually continue to a depth of several feet. Both the surface soil and subsoil contain a large quantity of fine waterworn gravel, making the phase porous and leachy.

This phase is confined to a few bodies in the Illinois River Valley and a narrow strip along Williams Creek. It has a smooth surface and is well drained. None of it is under cultivation, and the stunted growth of pine and fir on parts of it indicate a soil of low moisture-holding capacity. Without irrigation it has no agricultural value, and even if water were supplied the yields obtained on the stonier parts would probably not justify the great expense of clearing off the stones from the surface. The area on Rough and Ready Flat west of the West Fork of the Illinois River is adapted only to for-

estry. The body near Floyd School is less stony and has a somewhat higher value.

Below are given the average results of mechanical analyses of samples of the soil and subsoil of the typical Kerby gravelly loam:

Mechanical analyses of Kerby gravelly loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
561057, 561087	Soil	8.4	11.0	4.6	12.3	10.5	34.8	18.5
561058, 561088	Subsoil	3.6	9.0	4.1	11.2	10.5	34.7	26.8

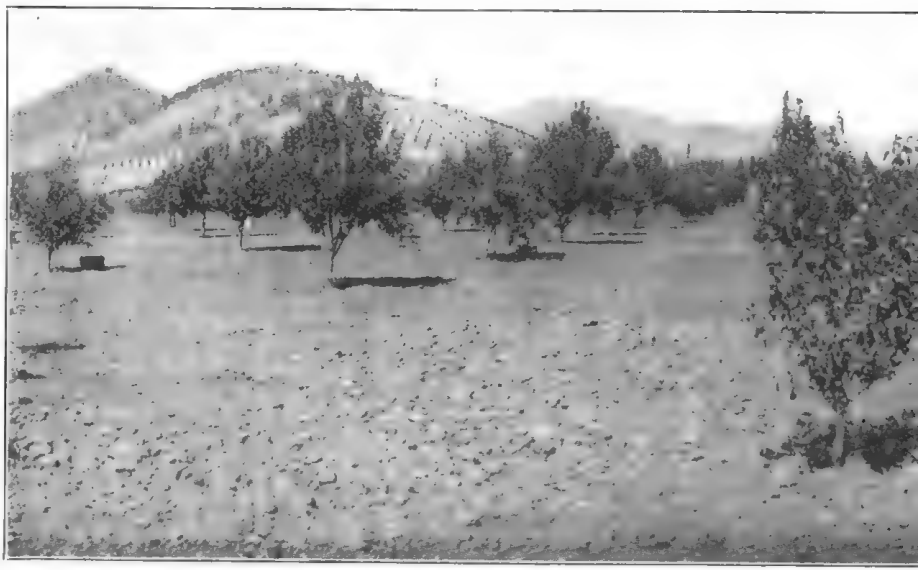
KERBY LOAM.

In the typical development of the Kerby loam the surface soil consists of a brown, brownish-yellow, or pale reddish brown friable loam, in places rather light in texture, extending to an average depth of about 12 inches. The subsoil consists of brownish-yellow or yellowish-brown loam or clay loam containing a large proportion of fine waterworn gravel, which continues with but little change to 6 feet or more in depth. In places the surface soil contains a small quantity of rounded gravel from mixed rocks, but the content is rarely sufficient to interfere with cultivation. Small pellets of cemented material are also common in some localities. The underlying gravelly deposits average rather deep, bedrock rarely being encountered within less than 20 feet of the surface.

As mapped in this survey, the type includes small areas of soil which, if more extensive, would have been mapped as a type of a distinct series. These areas are of local occurrence and are confined to old alluvial-fan and terrace deposits derived mainly from basic igneous rocks. In these areas the soil consists of about 12 inches of a brown friable loam, overlying a brown, heavier textured loam or clay loam subsoil extending to a depth of 3 feet or more. In virgin areas the soil contains a fair supply of organic matter, but this has been considerably reduced in the older cultivated fields. Fine angular particles of greenstone are present on the surface here and there in small areas, and in some places are uniformly distributed throughout the 3-foot section, but they are never sufficiently numerous to interfere with cultivation or to render the material porous or leachy. The subsoil is sufficiently compact to favor the retention of moisture but not so compact as to interfere with the development of plant roots. Only in small areas of restricted drainage is there a tendency toward a hardpan formation, and even here the layer is rarely more than a few inches thick. Typically the soil material has a depth of 10 to 15 feet and rests on basic igneous rocks.

The Kerby loam is confined to small bodies in widely separated parts of the county. An important body occurs along the south side of Sucker Creek, where it forms a somewhat broken strip extending from the East Fork of the Illinois River to beyond Holland. Other small bodies are scattered throughout the Illinois, the Applegate, and the Rogue River Valleys, and near Wolfcreek in the northern part of the county.

Small bodies of the included soil occur in the Rogue River Valley at the base of the mountains near Grants Pass, in the Applegate



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PEACHES ON OLYMPIC LOAM IN THE DISTANCE.

PEAR ORCHARD ON COLUMBIA FINE SANDY LOAM, IN THE ROGUE R

FIG. 1. APPLE ORCHARD ON COLUMBIA FINE SANDY LOAM, IRRIGATED BY MEANS OF PORTABLE PIPES.

FIG. 2. WINTER WHEAT ON TERRACE PHASE OF COLUMBIA LOAM, IN THE APPLEGATE RIVER VALLEY.

River Valley near Murphy, near Waldo, and about 2 miles east of Merlin.

The typical areas of the Kerby loam lie on terraces 20 to 50 or more feet above the normal flow of streams. The surface ranges from nearly level to very gently undulating, making irrigation possible without much leveling. In general, both the surface and internal drainage are excellent, although there are included a few narrow depressions of heavier texture in the vicinity of Holland which would be benefited by tile drains.

The local included areas, which are derived from basic igneous rocks, occur on smooth terraces which slope upward and merge into old alluvial fans and colluvial foothill areas of uniform but easy gradient. A few occur as narrow strips along intermittent streams. In all cases the surface is favorable for irrigation and drainage.

This type of soil is important only locally. About 20 per cent of it is under cultivation. Some of it is scantily covered with a brushy growth of chaparral, manzanita, ceanothus, and oaks, and the remainder is covered by a fairly good stand of fir and pine, or has been logged off and is growing up to brush. The same crops are grown and about the same yields are obtained as on the Kerby gravelly loam. The main crops near Grants Pass are pears and apples, and in other sections, alfalfa. The orchards are without irrigation, but most of the alfalfa is watered. The trees have but recently come into bearing, and although they have made a fairly satisfactory growth, the yields of fruit have been below normal, owing to the lack of moisture. (See Pl. I.) Irrigated alfalfa yields 3 to 5 tons per acre per season. Superphosphate is applied to some of the alfalfa fields at the rate of 150 to 200 pounds per acre, and sulphur is used on some of the red clover fields. The grains, which are grown mainly without irrigation, are principally of the winter varieties, as the spring-sown grains are frequently unprofitable because of the lack of rain during the early summer.

Lands of this type of soil at some distance from markets can be bought for $25 to $75 an acre, depending on improvements, location, and facilities for irrigation. Well-developed orchard tracts in the vicinity of Grants Pass are held at a much higher figure.

The Kerby loam is one of the most desirable soils in the area surveyed. It is early and easy to till, and a large proportion of it is irrigable. Under irrigation the well-drained areas appear to be well suited to apples and pears, and to practically all of the general farm crops grown in the county. The low places produce excellent alsike or red clover, as well as velvet grass and other pasture grasses, but in their present poorly drained condition are not well suited to alfalfa. Judging from the success attained in a small way in dairying in the vicinity of Holland, it would seem that this type is well adapted to dairy farming.

Kerby loam, stony phase.—The Kerby loam, stony phase, as mapped in this survey, is somewhat variable in texture. The surface soil usually consists of a brown friable loam carrying a large content of waterworn and subangular bowlders of greenstone. As a rule, the stony mass extends to a depth of 6 feet or more, the subsoil in places containing only a small proportion of fine material. The

surface soil ranges in texture from a heavy sandy loam to clay loam and in places contains much fine gravel.

This phase of the Kerby loam is confined to narrow strips along intermittent drainage ways, which either traverse or have their sources in areas of basic igneous rocks. Several areas occur in the vicinity of Murphy, Davidson, and Grants Pass, and others along the Pacific Highway near Merlin and Hugo.

In places the phase has the topography of high, smooth terraces, but more commonly it occurs on steep terrace slopes or on gently to steeply sloping alluvial fans. It is excessively drained, and the greater part of it is too stony and porous to be of much value for agriculture. A small acreage has been partly cleared of rocks and is being used for the production of apples and grapes. Without irrigation they have made a poor growth and the yields have not been satisfactory. The phase as a whole is adapted only to forestry and grazing.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the typical Kerby loam.

Mechanical analyses of Kerby loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
561059	Soil	1.4	5.4	4.5	20.2	20.3	34.0	14.0
561060	Subsoil	2.9	6.8	4.8	21.3	20.3	30.9	13.0

KERBY CLAY LOAM.

The Kerby clay loam is subject to some variation in texture, but in its typical development the surface soil consists of a yellowish-brown or brownish-yellow clay loam of moderately compact structure extending to a depth of 12 to 15 inches. The subsoil, to a depth of 3 feet or more, is a compact clay loam of slightly yellower color than the surface soil. The substratum is usually gravelly, and small, waterworn gravel fragments of mixed origin are common in places throughout the surface soil and subsoil. Where these gravelly areas are of sufficient extent they are shown on the map by gravel symbols. The gravelly deposits are very deep; hydraulic-mining cuts through some of the areas show irregularly stratified gravels extending to depths of more than 40 feet.

The principal variation included with this type is represented by a few small, unimportant areas of somewhat heavier texture occurring on the lower foot slopes in the vicinity of Holland, Waldo, and French Flat. In these areas the surface soil consists of 10 to 12 inches of dark-brown to slightly reddish brown compact clay. The subsoil, to a depth of 36 inches, is a brown to reddish-brown compact clay, usually containing small subangular fragments of rock. In places the surface soil shows more red when wet, but it is generally more brown than red. Here and there a few loose rocks of basic igneous origin are found on the surface.

When dry this soil has a tendency to bake and become very hard on the surface, and unless it is cultivated at the proper time it is rather difficult to handle.

The Kerby clay loam is confined mainly to long, narrow strips in the valley of Sucker Creek near Holland and along Deer Creek near

Selma. It is closely associated with the Kerby gravelly loam, and in places small bodies of the latter soil are probably included.

Along the base of some of the hills in the vicinity of Holland the soil differs somewhat from the typical in that the surface material is gravelly and considerably grayer in color. This variation is also derived from mixed materials, but serpentine rock, which outcrops in places on the lower slopes, has contributed a part of the gravel and given the grayer color and more compact structure of the surface soil. These areas dry out quickly in the absence of irrigation and are considered inferior to the typical soil.

The Kerby clay loam as typically developed, occupies smooth or gently undulating terraces at some elevation above streams. The included areas of heavy texture are derived from weathered colluvial fan or foot-slope materials having their source mainly in higher areas of serpentine rock. They have a gentle slope with good surface drainage.

Under irrigation some of the more level bodies of this type are in need of artificial drainage, as the compact or slightly cemented subsoil retards the downward movement of water, causing the soil to become too thoroughly saturated for best results. In general, however, the type is well drained, sufficiently smooth for irrigation without much leveling, and favorably situated with respect to the supply of irrigation water.

This type has little agricultural importance at present, except in the vicinity of Holland, where it is well farmed to wheat, alfalfa, and various pasture grasses. Probably 75 per cent of the typical Kerby clay loam is uncleared logged-off land supporting a growth of small trees and brush. Wheat yields 18 to 30 bushels, with an average of about 23 bushels per acre. Alfalfa, cut three times, yields 4 to 5 tons per acre. Other crops produce good yields. The land is farmed mainly under irrigation.

The included areas of heavy texture are mainly treeless and covered with a scattering growth of chaparral and native grasses. None of these are cultivated, and without irrigation they have no agricultural value except for a little spring and fall grazing.

Land of this type sells for $25 to $75 an acre, depending principally on improvements.

The typical Kerby clay loam is an excellent soil and is well adapted to the general farm crops of the area. If plowed when wet, the soil has a tendency to puddle, or run together; but once worked up, it retains its mellow tilth with a moderate amount of cultivation. The plowing under of alfalfa or other green-manure crops would help to correct the tendency to puddle and increase the moisture-holding capacity of the soil.

The table below gives the results of mechanical analyses of samples of the soil and subsoil of the Kerby clay loam:

Mechanical analyses of Kerby clay loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
561061	Soil	3.2	5.3	2.2	8.2	16.6	41.1	23.6
561062	Subsoil	2.3	3.1	1.7	9.8	16.8	43.0	23.2

COLUMBIA FINE SANDY LOAM.

The Columbia fine sandy loam, to a depth of 6 feet or more, consists of a micaceous, friable fine sandy loam. The color typically is brown, with a range from slightly grayish brown when dry to dark brown or nearly black when wet. Unlike the older soils of the stream terraces, no trace of red or yellow appears in either the surface soil or subsoil. As a rule no definite subsoil is developed, although a somewhat heavier layer is locally encountered at 15 to 20 inches in depth, and the lower subsoil in places contains a larger proportion of medium or coarse sand. Small pockets of waterworn gravel are also encountered at various depths below the surface foot, but their occurrence within the 6-foot section is unusual. In its natural state the soil is fairly well supplied with organic matter, but in many fields which have been long in cultivation the soil is deficient in humus.

The texture of the surface soil varies somewhat within short distances. As mapped in this area, the type includes bodies of medium sandy loam. In some localities the fine sandy loam and medium sandy loam materials occupy about equal areas, but their occurrence is such as to preclude a satisfactory separation on the map. Usually the fine sandy loam occurs in slight depressions and the sandy loam is more commonly found on the low swells and ridges.

The Columbia fine sandy loam is the principal recent-alluvial soil in the area surveyed. The largest bodies, comprising 2,000 acres or more, occupy a more or less broken strip one-eighth to three-fourths mile wide extending down the Rogue River from Grants Pass for about 12 miles. Other important bodies occur at various points along the Applegate River, the most prominent being those near the mouth of the river, at Newhope, Murphy, and between Murphy and Provolt. Less important bodies lie along Williams and Sucker Creeks.

In general this type has a smooth topography, although in places the surface is billowy or undulating owing to the occurrence of low swells and long, shallow depressions which were formed at a time when the land was periodically flooded. The surface is favorable for irrigation, and many fields are watered without previous leveling, but the irrigation is more expensive and less efficient than where the land has been properly prepared. The greater part of the type lies 15 to 30 feet above the normal flow of the streams, insuring excellent drainage and freedom from overflows.

Although the Columbia fine sandy loam is of relatively small extent, it is a very important soil. It produces considerable alfalfa and a large proportion of the fruit grown in the county. (See Pl. II.) Probably 90 per cent of it is under cultivation, and the greater part of the remainder has been cleared of the original timber growth and farmed to some extent in the past. At the present time the uncleared areas are covered with brush, which would entail little expense in clearing.

The principal crops are alfalfa, apples, and pears, with smaller acreages of peaches, cherries, corn, wheat, potatoes, hops, and vegetables. Dairying is carried on to some extent in connection with the production of alfalfa and corn, the latter sometimes being siloed and used for winter feed. Practically all the alfalfa is grown under irrigation. Four cuttings are usually obtained, with a total yield of 4 to 6 tons per acre, although the crop is sometimes cut only three

times and the fields pastured for several weeks in the fall. The first cutting is made the first week in May, and the fourth about the first week in October. In favorably situated areas two cuttings of about 1 ton each may be obtained without irrigation. Apples do well on this soil type, producing an average of 250 to 300 boxes per acre. Pears yield an average of 200 to 500 boxes per acre, depending on the age of the trees and the care they receive. Peaches and cherries ordinarily return excellent yields, although these crops are more likely to be damaged by spring frosts on this soil than when grown at slightly higher elevations. Corn and wheat are grown mostly without irrigation, the corn yielding 40 to 75 bushels and the wheat an average of about 25 bushels per acre. This is an excellent soil for potatoes, which are grown both with and without irrigation. The yield on the dry-farmed fields is about 150 bushels and with irrigation 200 to 300 bushels per acre. Hops, which are not ordinarily irrigated, yield 600 to 900 pounds, with an average of about 700 pounds per acre. Under irrigation yields of 1,000 to 1,200 pounds per acre are reported.

The Columbia fine sandy loam is one of the best-farmed soils in the county. A definite rotation is practiced by some, while others leave the fields in alfalfa as long as satisfactory yields are obtained. Where a systematic rotation is practiced alfalfa occupies the ground six years, corn two years, and small grains, usually barley or oats, two years, when the land is again sown to alfalfa. The alfalfa fields are prepared in the fall and are usually seeded without a nurse crop in the spring. Superphosphate at the rate of 150 to 200 pounds per acre is applied to the land at the time of seeding and each fall thereafter. Where the land is prepared for irrigation, the crop is watered once before the first cutting and twice before each succeeding cutting. Most of the orchards are irrigated. While some of the orchardists turn under alfalfa at regular intervals, others follow the practice of sowing clover every other spring, to be plowed under in the fall. Unirrigated orchards are given clean cultivation, although some are rather poorly cared for.

Land of this type that lies favorably for irrigation by pumping from the river sells for $150 to $200 an acre. Undeveloped tracts at some distance from transportation facilities can be bought for $75 to $150 an acre. Well-developed orchards are held at $500 to $800 or more an acre.

The Columbia fine sandy loam is a very desirable type of soil. The friable structure throughout the entire 6-foot section insures good drainage, and the nature of the surface soil makes it possible to maintain a mellow tilth with a minimum of cultivation. Continued cropping has reduced the supply of organic matter in many of the fields, and it is recommended that alfalfa or clover be turned under at more frequent intervals in order to restore this constituent. Superphosphate is decidedly beneficial to alfalfa and should be more generally used. It should be applied to old fields in the fall before damp weather begins, and to new seeding in the spring at a sufficiently early date to insure its being dissolved by rains before dry weather sets in. A blood and bone fertilizer containing potash has been found beneficial for potatoes, and its use is recommended. In many instances this type of soil is being irrigated without any preparatory leveling, the water being distributed by the use of movable galvanized pipes. (See Pl. III, fig. 1.) Since the land can

be cheaply leveled a saving of time and expense in irrigating could be effected by properly preparing the surface. Such preparation would also give a more uniform distribution of water.

The Columbia fine sandy loam is adapted to practically all of the crops grown in southern Oregon. It seems especially well suited to the production of alfalfa and fruit. The leading variety of apples is the Yellow Newtown, followed by the Winesap, and the Esopus (*Esopus Spitzenberg*). The principal varieties of pears are the Anjou, Bartlett, Bosc, Winter Nelis, and Howell; and of peaches, the Early and Late Crawford, and Elberta. This type of soil should be well adapted to potatoes, berries, and vegetables. Although favorably situated areas produce profitable yields under dry farming, irrigation is necessary for maximum results.

Columbia fine sandy loam, terrace phase.—The Columbia fine sandy loam, terrace phase, consists of a light-brown to brown friable fine sandy loam underlain at an average depth of about 12 inches by a brown to slightly yellowish brown, compact, fine sandy loam or sandy loam extending to an average depth of 30 inches. The substratum is usually more friable and porous than the subsoil, and consists of pale yellowish brown sandy loam, fine sandy loam, or loam, which in places contains a small quantity of fine waterworn gravel. The surface soil is deficient in organic matter.

The Columbia fine sandy loam, terrace phase, occurs in two small bodies, one in the vicinity of Grants Pass and the other near Williams. The surface is smooth, or gently undulating, and is well adapted to irrigation.

At present none of this phase is being farmed, but the timber has been removed and the land is covered principally with brush, native grass, or weeds. Under irrigation, it should be productive, easy to handle, and well adapted to practically all of the crops grown in the area.

This soil is really a distinct soil type, but in this area it is mapped as a phase of the Columbia fine sandy loam, in order to reduce the number of colors on the soil map. It could with propriety be classed as the Coleman fine sandy loam. It differs from the Columbia soil as follows: Its position is slightly higher; the surface soil is lighter in color and contains less organic matter; the subsoil is a distinct layer with a trace of yellow in its color, indicating greater maturity or a more advanced stage of weathering; and the substratum is lighter in color and more friable and porous.

Columbia fine sandy loam, gravelly phase.—The surface soil of the Columbia fine sandy loam, gravelly phase, consists typically of 10 to 18 inches of light-brown or grayish-brown to brown friable sandy loam, containing a quantity of waterworn gravel representing a variety of rocks. The soil is low in content of organic matter, and the structure is rather loose and porous. In the lower lying areas representing the more recent alluvial deposits the subsoil consists of lighter colored deposits of loose gravel and cobblestones, containing very little interstitial material, which extend to a depth of several feet. The gravel is of mixed origin, and although granitic and quartzitic rocks predominate, every formation in the region is represented in the material.

In the more elevated areas representing older and somewhat modified alluvial deposits the subsoil, to many feet in depth, consists of stratified deposits of waterworn gravel and cobblestones firmly em-

bedded in light-brown loam. In places the structure of the subsoil and substratum is loose and porous, but more commonly the underlying material consists of very compact or partly cemented layers in which gravel and cobblestones constitute 60 to 75 per cent of the total mass. The gravel fragments represent a variety of materials in which quartzites, granites, and hard igenous rocks predominate. In this area they are always well rounded, indicating that they have been transported considerable distances by streams. They range in size from one-half inch to 5 or 6 inches in diameter.

As mapped this phase includes undifferentiated areas of gravelly loam, the two soils being so intimately associated and so nearly of equal agricultural value that more detailed separations seemed unjustified.

The Columbia fine sandy loam, gravelly phase, occurs in long narrow strips throughout practically all of the valleys of the area surveyed. Some of the larger bodies occur on the low terraces along the Illinois River near Kerby, and at various points in the Rogue and Applegate River Valleys. Other bodies of more or less local importance are mapped along Williams Creek, along Louse Creek at Merlin, and along Grave and Wolf Creeks in the northern part of the area.

The larger and more elevated areas occupy smooth terraces 10 to 50 feet or more above the present courses of streams. The surface is gently sloping or very gently undulating, well drained, and capable of being irrigated without much leveling. In places, as in the vicinity of Grants Pass, this phase is closely associated with the Kerby gravelly loam, the two merging gradually into each other through shades of yellowish brown and yellow. It appears, however, that the greater part of this phase of the Columbia fine sandy loam is of somewhat more recent origin than the Kerby soils, since it occurs as definite stream terraces, whereas the Kerby types are frequently found on elevated flats which can not be positively identified with any existing stream.

The lower lying areas of more recent accumulation occupy shallow depressions or old overflow channels roughly paralleling the rivers, and low, narrow strips adjacent to the streams. These also occur as narrow, gently rounded ridges 2 or 3 feet above the surrounding soils. The lower lying parts of the phase are still subject to occasional overflow.

Although only a small proportion of this soil is under cultivation, it is of some importance locally. The greater part of it is still covered with a brushy growth of shrubs consisting of ceanothus, manzanita, laurel, and small oaks, pines, and firs, the larger timber having been removed for lumber. The principal crops are alfalfa, wheat, corn, and fruits. Alfalfa occupies the largest acreage, and like all the other crops except wheat, is grown only under irrigation. With an abundance of water, the yields average about the same as on the typical Columbia fine sandy loam.

Undeveloped tracts consisting mainly of this soil can be bought for $20 to $35 an acre. Improved lands under irrigation are held at $50 to $250 an acre, depending on location and improvements.

This phase of the Columbia fine sandy loam is a desirable soil where facilities are had for irrigation. Owing to its gravelly texture, it requires considerable water for best results. Except in some of the lower areas where the land is naturally subirrigated, the phase

is too droughty for successful dry farming. The soil is deficient in organic matter and would be greatly benefited by plowing under alfalfa or liberal applications of barnyard manure. Considering its marked adaptability to alfalfa, dairying would undoubtedly prove a successful type of farming for this soil.

This soil is really a distinct soil type, but in this area it is mapped as a phase of the Columbia fine sandy loam, in order to reduce the number of colors on the soil map. The greater part of it, including all the higher lying or terrace areas, could with propriety be classed as the Coleman gravelly sandy loam. This soil differs from the Columbia fine sandy loam as follows: It occurs on definite terraces above the first bottoms; the surface soil is lighter in color, coarser in texture, low in organic matter, and contains considerable gravel; the subsoil contains stratified deposits of gravel and cobblestones; the gravelly substratum in most places contains a compact or partly cemented layer, indicating greater age of the deposit; and, because of its texture and structure, this soil requires much water for irrigation, and most of it is too droughty for dry farming.

Columbia fine sandy loam, stony phase.—In places the material of the Columbia series contains a large quantity of loose, waterworn bowlders 6 inches to 1 foot or more in diameter. These areas are shown on the map by stone symbols. The fine material consists mainly of grayish-brown loam or fine sandy loam, but in places the phase consists of deep windrows of loose, rounded gravel and rocks with very little fine material.

This phase occurs in small bodies widely distributed throughout the valleys in all parts of the area surveyed. The most typical areas are found along the upper part of Williams Creek, along the East Fork of the Illinois River, and in the narrow valley of Jumpoff Joe Creek northeast of Merlin. Other bodies occur along Sucker and Grave Creeks.

The phase is confined mainly to low terraces a few feet above overflow. Drainage is excessive and the high content of stones renders the greater part of it nonagricultural.

This soil is mapped in this area as a phase of the Columbia fine sandy loam in order to reduce the number of colors on the soil map. This soil differs from the gravelly phase described above mainly in the larger content of stone. Since the gravel and stones completely mask the slight variations in the texture of the fine material, and consequently determine its character, this soil could with propriety be classed as the Coleman gravelly stony loam or as a stony phase of the Coleman gravelly sandy loam.

Columbia fine sandy loam, light-colored phase.—The Columbia fine sandy loam, light-colored phase, consists of about 12 inches of brownish-yellow or yellowish-brown, friable fine sandy loam or loamy fine sand, overlying brownish-yellow sandy loam or sand of fine to medium texture. The subsoil usually extends to a depth of 6 feet or more, where it passes into coarser sandy material containing waterworn gravel. The structure of the entire section is loose, and the soil is inclined to be porous. Typically no gravel or stones occur within 3 feet of the surface. The soil is mellow and is easily worked under a wide range of moisture conditions.

The phase is confined to very narrow strips along the Illinois River at Kerby and west of the Floyd School and one small body on a branch of Althouse Creek.

The surface in general is smooth, but contains some minor inequalities due to shallow channels caused by recent overflows. Both surface drainage and underdrainage are well developed.

This phase is unimportant. Only a very little is farmed, and the remainder is treeless or covered with a light stand of box elder and oak. It lies only a few feet above running streams and, with a small expense for leveling, could be easily irrigated. The soil is low in organic matter, but with an increase in this material the land should be well adapted to fruits and such cultivated crops as corn, potatoes, and vegetables.

The table below gives the results of mechanical analyses of samples of the soil and subsoil of the typical Columbia fine sandy loam:

Mechanical analyses of Columbia fine sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
561055	Soil	0.2	3.3	8.0	48.8	18.3	14.8	6.7
561056	Subsoil	.1	3.4	10.5	56.9	15.3	9.2	4.2

COLUMBIA LOAM.

The surface soil of the Columbia loam, to an average depth of 12 to 20 inches, is a dark grayish brown to dark-brown, micaceous, friable very fine sandy loam to loam, becoming darker colored when wet. In its virgin state the soil in the first few inches contains a large supply of organic matter, but in the older cultivated fields this has been reduced considerably by injudicious cropping. The subsoil is similar to the surface soil in color, but contains less humus, and is in places somewhat heavier textured and more compact. It ranges from a fine sandy loam or light loam to clay loam to an average depth of 3 or 4 feet, where it grades into more friable material of lighter color and texture. This type is free from gravel or other coarse material within the 6 foot section, although a gravelly substratum is sometimes encountered at depths of 15 to 20 feet. As mapped in this area the type includes a few narrow depressions having a clay loam surface soil, but these were not large enough to warrant separation on the map.

The Columbia loam is an inextensive soil type, occurring in small areas associated with the Columbia fine sandy loam in various parts of the Rogue and Applegate River Valleys. Important areas lie west of Grants Pass, particularly in sec. 19, T. 36 S., R. 6 W. Other small but important areas occur about 4 miles southwest of Merlin, near Provolt, along the East Fork of the Illinois River near the Floyd School, and on Althouse Creek and Democrat Gulch near the Spence School.

The topography varies from nearly level to gently undulating or billowy. The surface of the larger areas in the Rogue River Valley is marked by low swells and shallow depressions. The land can readily be irrigated without much leveling. Both the surface and internal drainage are good, and the texture and structure of the entire 6-foot section are such that the type retains a large supply of moisture for growing crops.

Regardless of its small extent, this type is of considerable agricultural importance. At least 90 per cent of it is under cultivation, and

the remainder could easily be cleared of its present growth of shrubs and brush. Practically every crop grown in the county is produced on this soil, the largest acreages being devoted to alfalfa, corn, apples, and wheat. Clover, hops, oats, and potatoes are of importance locally, and some of the low areas in the southern part of the county are devoted to pasture. Alfalfa under irrigation yields 5 to 6 tons per acre, depending on whether it is cut 3 or 4 times; oats yield 50 to 65 bushels, and apples yield 300 to 375 boxes per acre.

Owing to the marked ability of this soil to retain moisture, a large proportion of it is farmed without irrigation. In favorable locations dry-farmed alfalfa yields 2 to 5 tons; corn, 50 to 65 bushels; and wheat, 20 to 25 bushels per acre.

The type is handled and fertilized in the same way as the Columbia fine sandy loam, and has about the same range in value.

The Columbia loam ranks as one of the best soils in the county. It is productive, easily tilled, and adapted to a wide range of crops. Some of the lower areas are in need of drainage. The older cultivated fields are deficient in organic matter and should have alfalfa or clover plowed under to restore the supply of this material. As the land occupies a favorable position with respect to streams, the installation of irrigation would undoubtedly be found profitable.

Columbia loam, terrace phase.—The Columbia loam, terrace phase, consists of 12 to 20 inches of light-brown to grayish-brown fairly compact loam, generally relatively high in silt, overlying grayish-brown to slightly yellowish brown compact loam extending to an average depth of 30 inches. In places the upper subsoil is slightly cemented and has the characteristics of hardpan. The substratum is generally pervious and consists of a light yellowish-brown clay loam or friable fine to very fine sandy loam. Gravel is not common in the surface material but may be present in places in the subsoil. This soil is deficient in organic matter and as a consequence has a tendency to puddle if plowed when wet, and to bake and become hard on the surface if left untilled through the summer. Plowed at the proper time, however, it works up readily into a mellow tilth.

The Columbia loam, terrace phase, is confined to small areas on some of the lower terraces along the larger streams. The most important area is a narrow, irregular strip in the Rogue River bottoms a few miles southwest of Merlin. Other important areas occur near Provolt, and smaller ones along the upper part of Williams Creek, near Grants Pass, and at various points throughout the Holland section.

The topography is that of smooth terraces and very gently sloping alluvial fans. In places, as in the area southwest of Merlin, the phase occupies a slightly depressed position along the base of the hills and is separated from the river by the more undulating areas of the typical Columbia soils. In general the soil has adequate surface drainage, but in local areas the compact subsoil retards the downward movement of water and, after the surface has dried out, interferes with the capillary rise of water from below. Thus at times the pervious substratum is saturated while the soil and upper subsoil are unfavorably dry.

This phase of the Columbia loam is of minor agricultural importance. About 50 per cent of it is cultivated, and most of the remainder is covered with small oaks, manzanita, and laurel, with a

fair stand of pine near the head of Williams Creek. The principal crops are alfalfa, wheat, corn, clover, and apples. Alfalfa occupies the largest acreage. On some farms dairying is practiced in a small way, cream being shipped from Grants Pass to Portland. Under irrigation and with good treatment, the yields are similar to those obtained from the typical Columbia loam. (See Pl. III, Fig. 2.) Corn and wheat are usually dry-farmed and the other crops are irrigated.

Land of this phase can be bought for $25 to $150 an acre, depending on location, improvements, and irrigation facilities.

The Columbia loam, terrace phase, is a desirable soil, although it is considered somewhat inferior to the typical soils of the Columbia series. On account of the deficiency of organic matter it is rather difficult to work except under favorable conditions of moisture. The recommendations given for the improvement of the Columbia fine sandy loam are equally applicable to this soil.

This soil is really a distinct soil type, but in this area it is mapped as a phase of the Columbia loam, in order to reduce the number of colors on the soil map. It could with propriety be classed as the Coleman loam. It differs from the Columbia loam as follows: It occurs mainly on terraces above the first bottom; the surface soil is lighter in color, lower in organic matter, and less easily tilled: the subsoil is a distinct section, with a trace of yellow in its color; the upper subsoil in places contains a slightly cemented layer which interferes with the downward movement and capillary rise of water; and the substratum varies considerably in texture.

Columbia loam, poorly drained phase.—The Columbia loam, poorly drained phase, consists of 10 to 12 inches of light-brown loam overlying yellowish-brown compact clay slightly mottled with drab. At an average depth of about 24 inches the subsoil passes into a drab, impervious, compact clay, mottled with yellow and rusty brown. In small local areas the subsoil contains strata ranging from gray to nearly black. Gravel is absent or is of rare occurrence. The soil has a good supply of organic matter and under thorough tillage is very retentive of moisture.

This phase is confined to a few very narrow strips throughout the valleys in the central part of the area surveyed. Small but prominent bodies occur along Louse Creek near Merlin, along Williams Creek, in the Applegate River Valley near Murphy, and along Rogue River 4 miles east and also 8 miles west of Grants Pass.

This phase is unimportant. About one-half of it is farmed and the remainder is covered with brush and fir and pine trees. Alfalfa, grasses, and apples are the leading crops. In the Applegate Valley the alfalfa fields are irrigated and return yields of 4 to 5 tons of hay per acre. Some of the poorest drained fields in the Williams Creek Valley yield an average of about 1½ tons of timothy and mixed hay per acre. The area in the vicinity of Merlin is naturally subirrigated and the land is devoted to apples and pears. The young orchards are given clean cultivation. The trees are making a fairly satisfactory growth and give promise of developing into profitable orchards.

This phase is sold only in connection with other soil types. In places it should be provided with better underdrainage. When the land has been so improved and brought under irrigation it should prove to be one of the best soils in the county.

This soil is closely related to the terrace phase of the Columbia loam, described above, and it could with propriety be classed as a poorly drained phase of the Coleman loam.

Below are given the results of mechanical analyses of samples of the soil and subsoil of the typical Columbia loam:

Mechanical analyses of Columbia loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
561071	Soil	0.4	4.2	4.9	18.7	25.6	36.2	9.9
561072	Subsoil	.6	3.8	6.2	24.0	23.0	34.1	8.4

WAPATO CLAY.

The surface soil of the Wapato clay consists of dark-brown, drab, or dark grayish brown clay, mottled with yellow and brown, and in places rather silty in texture. The soil contains a large quantity of humus, which makes it friable and more easy to work than the ordinary soil of this texture. The subsoil, beginning at an average depth of about 12 inches, is a dark-brown or drab, compact, and rather impervious clay, showing considerable orange and rusty-brown mottling. As a rule the type is free from gravel, although fine shaly material is present on the surface in a few small areas. The texture varies somewhat in different parts of the survey; small areas of loam texture are included in some of the smaller valleys, and along the Illinois River a small acreage of clay loam occurs within the type. In the latter locality there is also included a small area of Muck and Peat, the soil consisting of 2 feet or more of organic matter in various stages of decomposition, resting on a subsoil similar to that of the main type.

The Wapato clay is confined to very narrow strips and is inextensive. It is found in the vicinity of Selma and Holland, and at various points within the Rogue and Illinois River valleys.

It occurs as nearly level areas along streams, and as low marginal strips at the foot of terrace slopes. Surface drainage is poorly developed, and in places the land is subject to occasional overflow. The compact subsoil gives it a restricted underdrainage, causing the water table in some of the marginal areas to stand within 3 feet of the surface until well into the summer. Most of the land lies only a few feet above the stream channels, and the surface requires almost no leveling for irrigation.

About half of the Wapato clay is farmed, and the remainder supports a good growth of native grasses highly prized for grazing. The principal crop is alfalfa, with wheat, corn, and clover following in importance. Only a small proportion of the type is irrigated, yet with good cultivation the yields are uniform and fairly profitable.

Land of this type can be bought for $50 to $75 an acre. Under irrigation it should be well adapted to all of the above-named crops and in addition should be well suited to the cultivated grasses. Some of the lower lying areas require artificial drainage to fit them for crop production. When these areas have been thus improved, they will rank with the better soils of the county.

The table below gives the results of mechanical analyses of samples of the soil and subsoil of the Wapato clay.

Mechanical analyses of Wapato clay.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
561023	Soil	0.4	0.8	1.0	6.2	7.3	37.8	46.6
561024	Subsoil	.8	2.2	1.2	7.3	8.6	38.1	41.8

RIVERWASH.

Riverwash consists of loose, porous deposits of waterworn gravel, cobblestones, and coarse sand, lying only a few feet above the normal flow of streams. Usually it consists mainly of loose gravel and bowlders, with very little fine material. It is confined to narrow strips bordering the Rogue, Applegate, and Illinois Rivers, and Sucker and Althouse Creeks, and to small islands within the larger streams. It is frequently flooded, and is devoid of vegetation except in the island areas, which are covered with brush.

A small acreage of the more sandy part is irrigated and seeded to alfalfa, but the yields are low. Owing to the high content of stones and gravel, and its subjection to floods, the type in the main has no agricultural value.

ROUGH MOUNTAINOUS LAND.

A large proportion of the area surveyed consists of rugged mountains which are too steep and broken for cultivation and are adapted only to forestry and grazing. The areas include all of the types mapped elsewhere throughout the hills, but since they are largely shallow or stony and nonagricultural in character they were not differentiated and are shown on the map in one color under the general term of Rough mountainous land. Topographic condition is thus made the principal basis of classification of this type of material, and only in this respect do the included soils differ from those mapped elsewhere as individual soil types. In general it may be said that in the eastern part of the county the soils are derived mainly from igneous rocks and usually consist of red or brownish surface soils and red, heavier textured subsoils overlying bedrock at any depth between a few inches and 6 feet. Here the soils are typical of the Aiken or Olympic series. Gray and brown coarse-textured soils derived from granite and belonging to the Siskiyou and Holland series are included with this type of material in the vicinity of Grants Pass and along Williams Creek in the southeastern part of the county. Elsewhere Rough mountainous land is composed of soils which have been formed mainly through the weathering of sedimentary rocks. These soils are either red, brown, or yellowish in color, rather heavy in texture, and represent the Sites, Hugo, or Josephine series. As mapped, this type necessarily includes a number of undifferentiated areas of Rough stony land, the difference in value of the two types being so slight as not to warrant a detailed separation.

Rough mountainous land is by far the most extensive type in this region. Combined with Rough stony land it comprises 53.7 per cent of the total area surveyed, and occupies the uplands almost to the exclusion of every other type. The largest body, cov-

ering about 80 square miles, occurs in the northwestern part of the area surveyed. Other large bodies, broken only by areas of Rough stony land, occur along the east side of the county, south of the Applegate River, and bordering Slate Creek and the Illinois River Valley.

The greater part of the Rough mountainous land has an extremely rough and rugged topography, consisting of steep mountain slopes rising 500 to 3,000 feet above the valleys, or to more than 5,000 feet above sea level. Except in a few small areas, drainage is everywhere excessive. Fully 95 per cent of this type is covered with a valuable stand of fir and pine, the growth usually being somewhat more dense and uniform than that on the areas of Rough stony land.

The Rough mountainous land has a small value for grazing purposes, and, as mapped, includes areas of a few acres each of arable soils. In general, however, the rough topography makes the type unsuitable for cultivation and renders it liable to erosion where the native covering is removed. It is best adapted to forestry.

ROUGH STONY LAND.

Throughout a considerable proportion of the area surveyed the land is not only too rough and mountainous for tillage but the soils are shallow and stony and rock outcrops are numerous. Such land is shown on the map as Rough stony land. Aside from its stony character, this type is similar to Rough mountainous land.

The entire type is considered nonagricultural and adapted only to forestry and grazing.

PLACER DIGGINGS.

Placer diggings is a type comprising a wide assortment of miscellaneous materials which have been washed out by placer-mining operations and redeposited in near-by areas.

The material has a very uneven surface, due to the piling up of the gravels by hydraulic mining. It is too stony and porous to support plant growth and has no value for agriculture.

IRRIGATION.

Irrigation began in Josephine County in 1855, when water was diverted from Sucker and Althouse Creeks onto the low terraces along these streams. By 1860, 15 water rights for irrigation had been established on these two streams. In 1858 irrigation began on Williams Creek, and by 1861 practically all of its waters, including the tributaries, had been appropriated. Development proceeded slowly through the seventies, followed by a period of greater activity during the next decade. As yet, however, only a small beginning has been made toward bringing the irrigable lands of the area under irrigation. At the present time the total acreage under irrigation is estimated at 30,000 acres. This is distributed approximately as follows: Sucker Creek, 2,462 acres; Althouse Creek, 749 acres; Rogue River Valley, including tributaries entering within the area surveyed, 17,571 acres; and 8,418 acres variously distributed throughout the county.

Since completion of the field work of this survey the Grants Pass irrigation district has been formed, and a dam is being completed on Rogue River which will provide a reservoir for a large volume of water for irrigation. At present (1920) this district includes 17,400

acres, of which 11,000 acres are reported to be irrigable. Extension of the district is now being urged to include 4,200 acres additional, of which 3,000 acres are reported to be irrigable, making a total of 14,000 acres to be watered in the vicinity of Grants Pass.

Rogue River is the largest perennial stream in the area, but owing to the fact that it is rather deeply intrenched, pumping has been necessary to bring water to the terraces, and as a result only a small acreage in the valley has been irrigated. According to reports of farmers, the average cost of pumping along this stream is about $3 per acre. This river maintains a strong flow throughout the entire year and is capable of providing water for all of the land it can be made to reach.

The Applegate River is also a strong-flowing stream whose waters are ample for the irrigation of the entire valley. Owing to its excellent fall, practically all of the lands capable of irrigation can be covered by a gravity system, thus eliminating the expense of pumping. Other streams along which there are a few acres of irrigated land are the Illinois River and Deer Creek in the southern part of the county, and Wolf, Grave, Jumpoff Joe, and Louse Creeks, in the northern part of the area. Practically all of the irrigation on these streams is accomplished by gravity systems. By impounding the surplus run-off of these streams a large additional acreage of irrigable lands could be brought under gravity ditches.

The principal irrigated crops grown in the county are alfalfa, apples, and pears, although there is a small irrigated acreage of practically every crop grown in the region. In all cases the results obtained by irrigation show that the expense incurred is amply justified, and the extension of the irrigated acreage wherever feasible can not be too strongly recommended. In fact, as a large proportion of the uncultivated area is too rough for cultivation, and much of the arable land is poorly suited to dry farming, any material expansion in agriculture is mainly dependent on the extension of irrigation. There are excellent opportunities in practically all of the valleys for further development along this line.

SUMMARY.

The Josephine County area is situated near the southwest corner of Oregon. It comprises 765 square miles, or only that part of the county not included in national forests. The area consists of rugged mountains with steep, heavily wooded slopes, and a number of smoothly terraced valleys. The mountains constitute by far the greater part of the area. The valleys range in elevation from 800 to 1,500 feet and the mountains from 2,000 to 5,000 feet above sea level. The area is well drained. The principal streams are the Rogue, Applegate, and Illinois Rivers.

The area is sparsely inhabited, only the valleys and lower foothills being settled. The population of the county is 7,655. Grants Pass, population 3,151, is the largest town. In addition there are about 20 other towns and settlements throughout the valleys having 50 to 300 inhabitants.

The main San Francisco-Portland line of the Southern Pacific Railroad passes through the central and northern parts of the area, giving direct communication with San Francisco and Portland. A branch line extending from Grants Pass to Waters Creek is of importance to the lumbering and mining industries.

The principal markets for stone fruits are Portland and San Francisco. Apples and pears are marketed mainly in the eastern cities. Cream is shipped to Portland and Independence, Oreg.

The climate of the valleys is unusually pleasant and agreeable. The temperature is favorable to the growth of a wide range of crops. The annual precipitation of Grants Pass is 31.78 inches, of which 75 per cent falls during the five winter months. The summers are usually dry.

The area was first settled by miners about 1848. They were soon followed by more permanent settlers who began irrigating the level valleys in the southern part of the county. The agricultural development of the county, however, has been slow, owing to the reluctance of the farmers to incur the expense for irrigation.

Apples and pears are the principal cash crops. Alfalfa occupies the largest acreage, and although there is a considerable acreage of other forage crops grown, the amount of hay and forage is insufficient to supply the local demand, and quantities are shipped in annually. Dairying, or the shipping of cream, is becoming an important industry. Wheat, corn, potatoes, and vegetables are grown in a small way on nearly every farm. Barley, oats, and clover occupy a small acreage, and grapes are beginning to assume importance as a cash crop in the vicinity of Grants Pass.

The supply of farm labor is fairly abundant, and the quality is good. Most of the laborers are Americans.

Of the total area in Josephine County, less than 10 per cent is in farms. The average size of farms is 133.8 acres, of which 40.6 acres is classed as improved.

Irrigated valley lands, improved for general farming, sell for $150 to $250 an acre. Well-improved orchards sell for $350 to $1,000 an acre. Unimproved lands suitable for irrigation can be bought for $25 to $35 an acre.

The soils of the area are numerous and fall into two general groups, residual and transported. The residual soils occupy the hills and are derived through the weathering of either igneous or sedimentary rocks. The igneous rocks give rise to 4 soil series, the Olympic, Aiken, Siskiyou, and Holland. The sedimentary rocks produce three soil series, the Sites, Hugo, and Josephine. The transported soils include soil derived from old valley-filling deposits and recent-alluvial soils of the stream bottoms. The former give rise to a large variety of soils which are grouped into five soil series. Of these the most important are the Corning and the Kerby. The recent stream bottoms give rise to the Columbia and Wapata soil series. The Columbia soils are among the most important in the area. The recent-alluvial soils, however, are of relatively small extent.

Where irrigation has been provided the soils of Josephine County have proved well adapted to a wide range of crops. Many of them seem especially well suited to alfalfa, pears, and apples. The cultivated areas are confined to small tracts throughout the valleys. Irrigation has been provided for 30,000 acres, but with the completion of the dam across Rogue River an additional 14,000 can be watered in the vicinity of Grants Pass. Throughout the Rogue and Illinois Valleys there are excellent opportunities for profitably extending the irrigated acreage.

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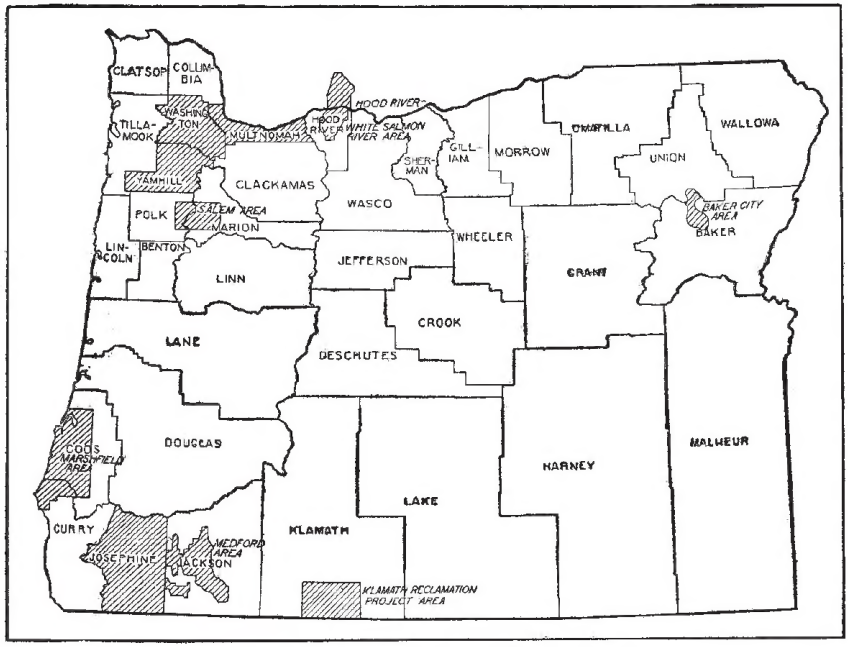

Areas surveyed in Oregon, shown by shading.

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U. S. DEPARTMENT OF AGRICULTURE
BUREAU OF SOILS
IN COOPERATION WITH THE
OREGON AGRICULTURAL EXPERIMENT STATION

SOIL MAP

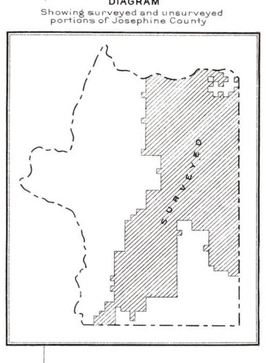
OREGON
JOSEPHINE COUNTY SHEET

LEGEND

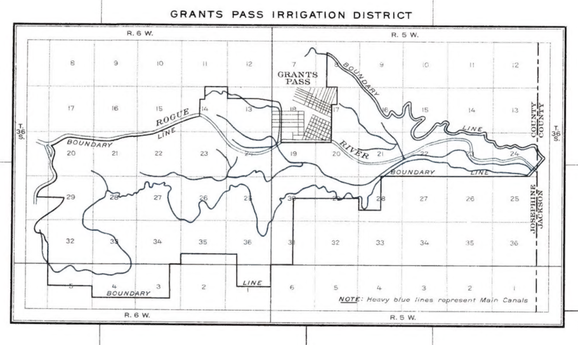
- Aiken clay loam
- Holland coarse sandy loam
- Stony phase
- Heavy phase
- Barron coarse sandy loam
- Hugo silt loam
- Clawson silt loam
- Jerome sandy loam
- Sandy phase
- Dark-colored phase
- Josephine clay loam
- Heavy phase
- Columbia fine sandy loam
- Kerby gravelly loam
- Terrace phase
- Stony phase
- Kerby loam
- Light-colored phase
- Gravelly phase
- Stony phase
- Kerby clay loam
- Stony phase
- Columbia loam
- Olympic loam
- Terrace phase
- Siskiyou coarse sandy loam
- Poorly drained phase
- Sites gravelly clay loam
- Corning gravelly loam
- Deep phase
- Corning gravelly clay loam
- Stony phase
- Corning clay loam
- Sites clay loam
- Alluvial fan phase
- Wapato clay
- Light-textured phase
- Riverwash
- Placer diggings
- Rough stony land
- Rough mountainous land

DIAGRAM

Showing surveyed and unsurveyed portions of Josephine County



GRANTS PASS IRRIGATION DISTRICT



CONVENTIONAL SIGNS

CULTURE
(Printed in black.)

- City or Village, Roads, Buildings, Wharves, Jetties, Breakwater, Levee, Lighthouse, Fort
- Secondary roads and Trails
- Railroads, Steam and Electric
- Bridges, Ferry
- R.R. crossings, Tunnel
- Ford, Dam
- School or Church, Cemeteries
- Mine or Quarry, Mine dumps, Made land
- Bluff, Escarpment, Rock outcrop and Triangulation station
- Stony and Gravelly areas
- Soil boundaries
- Boundary lines
- Boundary lines
- Boundary lines
- U. S. township and section lines

RELIEF
(Printed in brown or black.)

- Contours, Depressions, contours
- Prominent Hill, Mountain Peak
- Sand, Wash, and Sand dunes
- Shore and Low water line, Sandbar

DRAINAGE
(Printed in blue.)

- Streams
- Lakes, Ponds, Intermittent lakes
- Intermittent streams
- Springs, Canals and Ditches, Flumes
- Swamp, Salt marshes
- Submerged marsh, Tidal flats

The above signs are in current use on the soil maps. Variations from this range appear in some maps of earlier dates.

Soils surveyed by A. E. Kocher of the U. S. Department of Agriculture, in charge, and E. F. Torgerson of the Oregon Agricultural Experiment Station.

BASE MAP COMPILED FROM U. S. GEOLOGICAL SURVEY SHEETS

Scale 1 inch = 1 mile

A. Hoen & Co. Baltimore

Field Operations Bureau of Soils 1919